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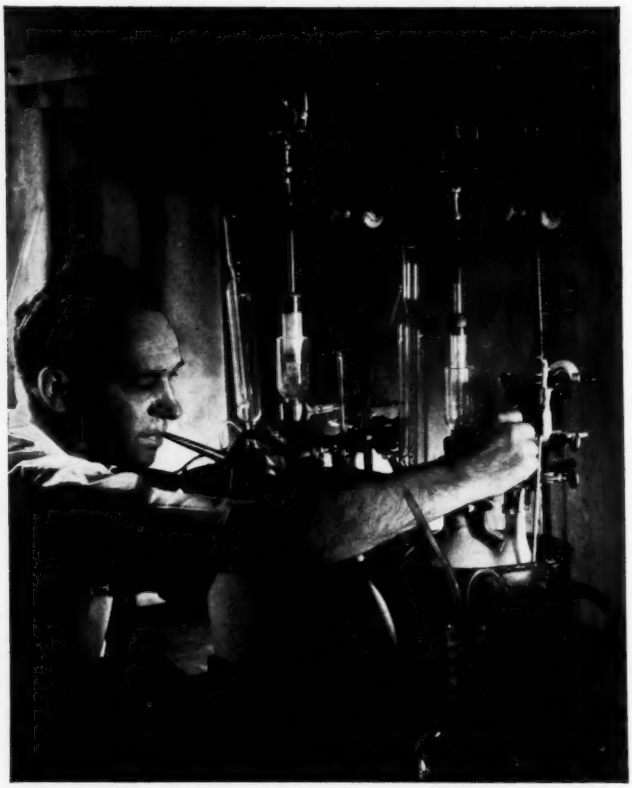

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NOVEMBER 27, 1939

VOLUME 28 NUMBER 24

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Calco Plant in 1915

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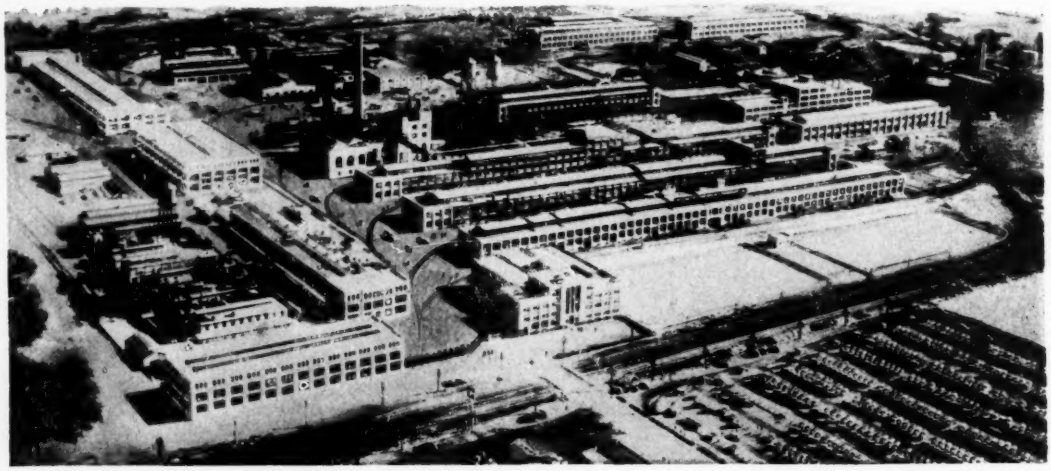

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AMERICAN
DYESTUFF REPORTER

VOLUME 28 NOVEMBER 27, 1939 NUMBER 24

Recent Developments in Methods for

Shrinkproofing Wool

B. A. HAROLD

THE production of woolen fabrics which can be marketed as merchandise which is shrinkproof has lucrative possibilities from a retailing standpoint. However, the commercial practicability of any shrinkproofing process is dependent upon unimpairment of tensile strength, elasticity and any other damage of the fabric which might affect its wearing qualities.

Research workers have attempted for many years to produce an accurately controlled chemical treatment which would result in woolens of these optimum properties. During this time the major attempts were made to apply chlorine solutions in such a manner as to produce a minimum of damage in the wool. During the early research it was readily apparent that hypochlorous acid in low concentrations showed the best promise. It may be well to point out that the greatest amount of development work along these lines has emanated from Europe, as little has been forthcoming from investigations made in this country.

Trotman[1] found that while a dilute solution of hypochlorous acid containing 5 grams per liter of available chlorine might be used with safety, the damage produced increased rapidly with the concentration. This was found to be caused by the gradual liberation of free chlorine.

Trotman carried out a number of interesting experiments in which he studied the effect of adding various acids, buffers and protective agents to the hypochlorous acid, hoping to attain an optimum combination whereby a minimum of damage would be produced in the wool.

Inasmuch as the pH of hypochlorous acid is approximately 6.0, it was natural to conclude that if this solution could be kept on the acid side, there would be less chance for damage. To maintain this, three acids—hydrochloric, oxalic and lactic—were tried, with the result that the amount of damage varied from 24 per cent to 30 per cent; the hydrochloric acid showing the least damage of the three.

An acid buffer such as sodium dihydrogen pyrophosphate was also used and this salt produced damage of 20 per cent to 23 per cent. Other acid buffers such as potassium alum and aluminum sulfate did not improve the damage.

Protective colloids when added to the hypochlorous acid solution produced little change as far as improving damage. These included gums, starches and dextrines. Tannic acid and synthetic tans were also of no avail.

Protective colloids like glues and gelatins in the presence of hypochlorous acid produced good protective action, but the drawback was that if any free chlorine is present there is a reaction which produces chloro-amine, resulting in the loss of potency of the glue or gelatin. Thusly, a fabric treated with hypochlorous acid, which was made from the interaction of calcium hypochlorite and boric acid to which .5 per cent of gelatin was added, showed damage of only 10 per cent with a maximum shrinkage of 9.5 per cent.

Formaldehyde had a peculiar action. It tended to reduce shrinkability as well as felting power of the wool, but this effect was not permanent, as when the formaldehyde was removed by washing, shrinkage occurred.

Phenols were found to be excellent for protection when used with hypochlorous acid. Trotman carried out an experiment in a practical way as follows:

> Hypochlorous acid was prepared from bleaching powder and boric acid, and the phenol added to it, the proportions being, available chlorine—3-5½ lbs., phenol 0.5 lb. and boric acid 2-3 lbs. for 100 lbs. of goods. The material was worked in this solution for 30 minutes, following which it was washed with cold water and then soured in a solution of sodium sulfite acidified with sulfuric acid.

The fabrics treated by the above process when compared with those subjected to the usual sodium hypochlorite—HCl solutions, were found to be damaged to a far less extent, the percentage of damage varying from 11 per cent to 15 per cent against 60 per cent by the latter process. Secondly, the tensile strength and elasticity by comparison were shown to be better. It was noted that the effect of the phenol-hypochlorous acid method upon the wool differed from that of the other chlorine methods, as the goods were difficult to bleach with either SO_2 or H_2O_2.

Trotman conducted experiments to discover compounds free from chlorine which might shrinkproof wool. He

tried metallic oxides, various metallic salts and gelatin tannate, but none of these proved very successful.

It was found that zinc chloride, however, reduced the shrinkability of wool. If a fabric was first chlorinated in a light solution of chlorine—0.25 per cent to 0.5 per cent Cl_2—soured, and then treated with zinc chloride, a high degree of unshrinkability was produced as shown in the following table:

TABLE I

% Chlorine	*% Damage*	*% Shrinkage*
0.5	13	2.7
0.5	11	2.0
0.25	7	4.0

The action upon wool damage of various electrolytes[2] when added to chlorine solutions of varied concentrations has proved of interest. An electrolyte like common salt when used with a 3 per cent chlorine solution will increase the damage produced in the wool, this varying in proportion with the concentration of the salt up to 5 grams per liter. However, with a 5 per cent chlorine solution, the percentage of damage is hardly affected or, if anything, reduced. It was, therefore, concluded that sodium chloride should be always used when high percentages of chlorine are present.

Of all compounds investigated, it was found that sodium acetate yielded the best results as regards reduction of wool damage by chlorine solutions. This held true even at elevated temperatures, as shown in Table II.

TABLE II

Combination	*Damage*
3% Cl_2 alone at 100° F.	14.2%
3% Cl_2 alone at 140° F.	28.5%
3% Cl_2 plus sodium acetate at 100° F.	7.3%
3% Cl_2 plus sodium acetate at 140° F.	21.0%

Sodium acetate added to 1 per cent chlorine solution at room temperature produces 5 per cent of damage and only 6 per cent of shrinkage, which is good from a commercial standpoint. This shrinkage is equivalent to a 3 per cent chlorine solution alone which produces far greater damage. Results indicated that sodium acetate did not affect the dyeing properties of the treated wool.

Another member of the halogen family, i.e., of lower chemical activity, bromine, was investigated as a possible substitute for chlorine as a shrink-proofing agent for wool[3]. These investigations have proved of great interest, a bromine was found to be readily absorbed by wool from aqueous solution with less damage than that produced by chlorine. This is illustrated in Table III.

TABLE III

Treatment	*% Absorbed*	*% Damage*
3% Chlorine	2.62	26%
7% Bromine	6.75	6%
10% Bromine	8.24	7%
20% Bromine	17.84	20%
25% Bromine	21.84	22%

It can be readily seen from the above table that bromine is far milder in its reaction than chlorine as 25 per cent of bromine is equivalent in chemical activity to 10 per cent of chlorine. Bromine, when added to a chlorine solution, was found to reduce its destructive affect upon wool.

A comparison (Table IV) of the mildest combination of chlorine—chlorine plus sodium acetate—with bromine has indicated that bromine reduces shrinkage sufficiently for commercial purposes.

TABLE IV

Method	*% Damage*	*% Shrinkage*
Untreated fabric	—	19.0
3% Cl_2 plus NaOAc	5	6.0
7% Bromine	4	10.0
2% Bromine	4	9.4
1% Bromine	5	9.5
0.5% Bromine	—	11.0

As with chlorine it was found best to add sodium acetate when concentrations of over 5 per cent bromine were used in order to reduce damage. The addition of sodium acetate reduced the damage produced by 5 per cent bromine from 5 per cent to 2.2 per cent. It might be added that following the bromine treatment, the wool is de-brominated with a sour of sulfurous acid.

Table V indicates that the bromination of wool neither diminishes its tensile strength nor its extensibility. In fact, there occurs a slight increase in both. As regards dyeing properties, in general, the affinity of brominated wool for dyes was found to lie intermediate between that untreated and chlorinated wool.

TABLE V

		Undyed	*Undyed*	*Dyed*
Untreated	(Tensile [oz.])	7.37	6.13	4.30
	(Elongation [%]) .	15.1	15.8	11.20
2% Bromine	(Tensile [oz.])..	7.33	7.24	5.60
	(Elongation [%])	16.3	18.2	15.0
2% Bromine plus sodium Acetate	(Tensile [oz.])..	7.02	...	...
	(Elongation [%])	17.4	...	....

The advantages of the bromination process for wool when compared with the chlorination process are:

1. Bromine is readily adsorbed by wool from aqueous solutions.
2. The structural damage produced is less than that caused by an equivalent quantity of Cl_2.
3. The unshrinkability produced in the wool is commercially satisfactory.
4. The handle of the treated material is good, and it responds readily to bleaching.
5. Considering that only dilute solutions of bromine are necessary, these are less irritating than the more concentrated chlorine solutions.

Recently two processes have been disclosed in which wool has been rendered shrinkproof by (1) organic hypochlorites and (2) sulfuryl chloride. In both of these developments, success depends to a very measurable extent

upon the moisture present in the wool before it is subjected to the chemical action.

The shrinkproofing of wool by use of organic hypochlorites has been patented[4] by Reichert and Peakes, the latter being an experimental worker at Edgwood Arsenal, Maryland. The process, incidentally, is open to use by the United States government without payment of royalty.

According to the inventors, the introduction of less than 1 per cent of chlorine into a woolen fabric is enough to prevent shrinking of the material when it is subjected to normal washing. In order to render wool unshrinkable when washed at high temperatures, however, it is necessary to introduce high percentages of chlorine into the wool. Organic hypochlorites such as tertiary butyl hypochlorite, or tertiary amyl hypochlorite, were found to be very efficient chlorinating agents for permanently fixing chlorine on wool without damaging it.

The speed of the chlorinating reaction is controlled by allowing the moisture in the wool under treatment to come to equilibrium with that in an atmosphere of a definitely controlled relative humidity previous to processing. The optimum percentage of moisture was found to be 81 per cent at 25 degrees C. The speed of chlorination may be increased or decreased by raising or lowering the moisture content of the goods. This is illustrated in Table VI.

TABLE VI

Relative Humidity	*Time (Hours)*	*Temperature (Degrees C.)*	*Active Chlorine in Wool*
67	2	40	2.4%
81	½	40	1.6%
81	1½	40	5.3%

In this manner as high as 5 per cent of active chlorine may be introduced into the wool without causing appreciable damage to the material. By impregnating the wool first with an acid buffer such as sodium acetate, acceleration of the chlorination reaction ensues which allows a greater amount of Cl_2 to be introduced into the wool without damage. This is carried out as follows:

Wool is immersed in a 1 per cent solution of sodium acetate so as to leave 1½ per cent of the weight of the material as sodium acetate. The material is then dried, allowed to come to equilibrium with a relative humidity of 81 per cent at 25 degrees C. The wool is then immersed in a solution of tertiary butyl hypochlorite at 34 degrees C. for four hours.

Table VII shows the increased absorption of chlorine by wool in the presence of sodium acetate.

TABLE VII

Sodium Acetate Impregnation	*Relative Humidity*	*Time (Hours)*	*Temperature Degrees C.*	*Active Cl_2 in Wool*
1½%	81%	1	34	3.8
0%	81%	2½	34	2.6

An increase in temperature will cause an increase in the percentage of chlorine absorbed by wool previously treated with sodium acetate. This is illustrated in Table VIII.

TABLE VIII

Relative Humidity	*Time (Hours)*	*Temperature Degrees C*	*Active Chlorine in Wool*
75	18	24	3.5%
67	2	40	2.4%
81	1½	40	5.3%

It is claimed by the inventors that by first impregnating wool with the acid buffer, sodium acetate, it is possible to fix as high as 8 per cent of active Cl_2 by weight in the wool, without causing appreciable damage.

Following the chlorination of the wool with the tertiary butyl hypochlorite, the material may be either washed with carbon tetrachloride or dechlorinated with sodium bisulfite, sodium thiosulfate, or with any good souring agent. It may be brought out that tertiary amy hypochlorite may be substituted for the butyl compound with identical results.

The successful use of organic hypochlorites for shrinkproofing wool is dependent upon the following conditions:

(1) Moisture content of the wool.
(2) Temperature.
(3) Time of chlorination.
(4) Dilution of chlorinating agent.

The sulfuryl chloride process for shrinkproofing wool was developed by Hall[5] and this method known commercially as the Dri-Sol process has been reviewed to a great extent in recent textile literature. A brief description of the procedures is as follows:

The process consists of steeping wool for one hour at room temperature in a 2 per cent solution of sulfuryl chloride in white spirit. Carbon tetrachloride or trichlorethylene may be substituted for the white spirit as a solvent but they are too costly. In this treatment it is claimed that for each 100 pounds of wool there is lost but 1½ gallons of white spirit and not more than 10 lbs. of sulfuryl chloride.

The wool is then extracted, the extract being recovered, and this is followed by a wash with water. Due to the hydrolysis of the sulfuryl chloride to produce sulfuric and hydrochloric acids, it is necessary to neutralize these with either sodium carbonate or ammonia. The Dri-Sol process is claimed to produce wool of zero shrinkability without damage.

The theory of shrinkproofing wool with sulfuryl chloride is that the natural moisture content of the wool hydrolyzes the compound to produce HCl and H_2SO_4 which are apparently within the fiber in a nascent state. These act to destroy the felting properties of the wool. Unlike chlorination, the process is an acid one and not one of oxidation.

Chromyl chloride, possessing the formula CrO_2Cl_2, has been suggested as a shrinkproofing agent for wool[6]. This compound is a blood red liquid, having a specific gravity twice that of water, and a boiling point of 116 degrees C. It is prepared by distilling common salt, sulfuric acid and potassium bichromate together. Chromyl chloride when poured into water decomposes violently with the production

(Concluded on page 704)

Papers Presented at the Annual Conference of

The Textile Institute (England)*

May 30—June 3, 1939

Abstracted by JOHN H. SKINKLE**

THIS conference covered the manufacture, properties, processing, and dyeing of the various newly developed fibers. In the course of the conference, the following new fibers were touched upon either briefly or at length.

All protein fibers designed to imitate wool (casein fibers)

1. Lanital (Italy)
2. Tiolan (Germany)
3. Polan (Poland)
4. Lactofil and Casolana (Holland)
5. Cargan (Belgium)
6. Courtauld's casein fiber (England)

Viscose fibers with 3-5 per cent casein incorporated to give wool-dyeing properties

1. Cisalpha or Cisalfa (Italy)
2. Fibramine (Belgium)

Viscose fibers chemically modified to give affinity for acid dyes (basified viscose)

1. Rayolana WD (England)
2. Vistralan, Cupralan, and Artilana (Germany)

Fibers produced from synthetic resins

1. Igelite (Germany)
2. Vinyarn or Vinyon (U. S. A.)

Viscose or acetate fibers altered in physical properties to give increased strength, rough surfaces, crimp, etc.

1. Vistra, Agfa, Aceta, Lanusa, Visca, Flox, Floxalan, Schwarze-Zellwolle, Rhodia, Lanalbene (Germany)
2. Sniafiocco (Italy)
3. Velna (Belgium)
4. Tenasco, "Fort" fibers (England)
5. Teca (U. S. A.)

Glass fiber

Nylon

Cottonized bast fibers

A paper on "Rayolana" X and "Rayolana" W.D. was given by H. A. Thomas; these fibers were described as being not substitutes for the natural fibers but complementary fibers for the production of novel yarns and fabrics. They are fibers which may be blended with wool and which have wool dyeing properties, their tensile strength when dry is greater than wool but lower when wet, they also possess a lower extensibility than wool when wet. The fibers show a higher affinity than either cotton or viscose for the direct cotton colors but the light fastness of the dyes is considerably decreased except in the case of selected dyes; a list of suitable dyes is given. Fabrics made of these fibers have a soft wooly handle, are easily laundered, and are more water-repellent than viscose so that they are rapid drying.

L. Rose presented a paper on "Tenasco," a new class of high tenacity yarns made by a modification of the ordinary viscose process which consists in applying graduated stretch to the plastic filaments during their formation. The most highly stretched form of this fiber, which has the maximum strength, is now being used for heavy-duty motor tires. This fiber is also used as a source of a strong staple fiber which may be spun on the cotton system to produce higher counts of yarn (120's instead of 80's) than have been hitherto possible; these yarns have made successful shirtings.

"Teca — Its Properties and Utilization" by Harold DeWitt Smith was a summary of the properties of this new family of acetate rayon staple fibers which are manufactured with an inherent crimp; that is, the crimped form is the normal form of the fiber and the crimp would not be lost in processing. Teca may be used alone or in combination with any of the other fibers; it may be obtained in seven different deniers for proper blending. Teca is dyed with the ordinary acetate dyes and may be dyed in package form, high temperatures and strong alkalies must be avoided as must also over-drying. The desirable properties of Teca are its crimp and resilience which give a crushing and wrinkle resistance without any resin treatment; its warmth was stated as being comparable with wool. Present applications of this fiber are women's knitted outerwear, women's dress fabrics, and (in 15 per cent to 50 per cent blends) for men's and women's summer suitings.

A paper on "Glass Fiber Textiles" by A. L. Forster presented the properties of this new fiber. Glass fiber is characterized by a high tensile strength, it is practically non-hygroscopic, rotproof, vermin proof, non-inflammable, resistant to acids but attacked by alkalies, and resistant

(Continued on page 703)

*Full report of this conference will be found in the July 1939 Edition of the Journal of Textile Institute.

**Lowell Textile Institute.

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NOVEMBER 27, 1939

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• CALENDAR • OF COMING EVENTS

Mid-West Section announces the opening of a new series of educational lectures on subjects relating to textile processing on December 1, 1939. The speaker is Dr. Malcolm Dole, Northwestern University, on "Structure of Textile Fibers." The meeting will be held at the lecture hall of the Chicago Lighting Institute in the Civic Opera Building, 36th Floor, 20 North Wacker Drive, Chicago, at 8 P.M. All persons interested are invited to attend.

Meeting, New York Section, Chemists' Club, New York, N. Y., December 1, 1939. Speaker: Werner von Bergen, Forstmann Woolen Co., "Quality Control in Woolen Mills."

Meeting, Philadelphia Section, Penn A. C., December 8, 1939.

Fall Meeting, South Central Section, Andrew Johnson Hotel, Knoxville, Tenn., December 9, 1939.

Speakers: Philip H. Stott, E. I. du Pont de Nemours & Co., Inc., "Nylon"; Dr. John L. Kind, University of Tennessee will discuss the book "Mein Kampf."

(This is the date of the Auburn-Tennessee football game.)

Annual Meeting and Convention, auspices New York Section, 1940. Date to be announced later.

Technical Evaluation of

Textile Finishing Treatments*

Flexibility and Drape as Measurable Properties of Fabric

LELIA J. WINN** and EDWARD R. SCHWARZ, F.T.I.†

INTRODUCTION

A SERIES of ten fabrics, ranging from organdie through tracing cloth to a thick, stiff-finished cotton material, and varying in weight from approximately 5 milligrams per square centimeter (1.46 ounces per square yard) to approximately 45 milligrams per square centimeter (13.25 ounces per square yard), have been compared for bending length, rigidity, bending modulus, bending torque, chord length and radius of curvature by means of the drape tester, the hanging loop, Gurley stiffness tester and the Schiefer flexometer. The tests were all conducted in an atmosphere closely approximating standard conditions after adequate conditioning of the samples in this same atmosphere. (Tables I and II)

TABLE I
Fabric Weight

	mgm./cm.²	*oz./yd.²*
Unlaundered Organdie	4.96	1.46
Laundered Organdie	5.26	1.55
Tracing Cloth	10.80	3.19
Treated Thin Cotton	10.95	3.23
Plain Thin Cotton	11.31	3.34
"Velvet"	16.04	4.73
Plain Congo	23.37	6.89
A. C. Congo	26.09	7.70
Treated Thick Cotton	42.70	12.60
Plain Thick Cotton	44.92	13.25

TABLE II
Fabric Thickness

	(Thousandths of an inch)
Treated Thick Cotton	31.7
Plain Thick Cotton	27.1
"Velvet"	21.1
Plain Congo	14.7
A. C. Congo	14.5
Treated Thin Cotton	8.4
Laundered Organdie	6.9
Plain Thin Cotton	6.3
Unlaundered Organdie	6.0
Tracing Cloth	3.25

*Presented at Annual Meeting, Boston, Mass., September 15, 1939.

**A.A.T.C.C. Research Assistant, M.I.T.
†Professor of Textile Technology, M.I.T.

SUMMARY OF TEST METHODS

The Gurley stiffness tester was designed to handle paper rather than fabric and is influenced somewhat by the surface roughness of cloth as compared with a smooth paper. Further work may develop a satisfactory technique, but at present the results by this instrument show imperfect correlation with results by other methods.

The Schiefer flexometer has been described in the literature and the results of numerous tests are available. It was used in this investigation because it measures the force necessary to distort a sample (or pair of samples) by bending when the weight of the sample is eliminated by reason of the method of insertion of the sample in the instrument.

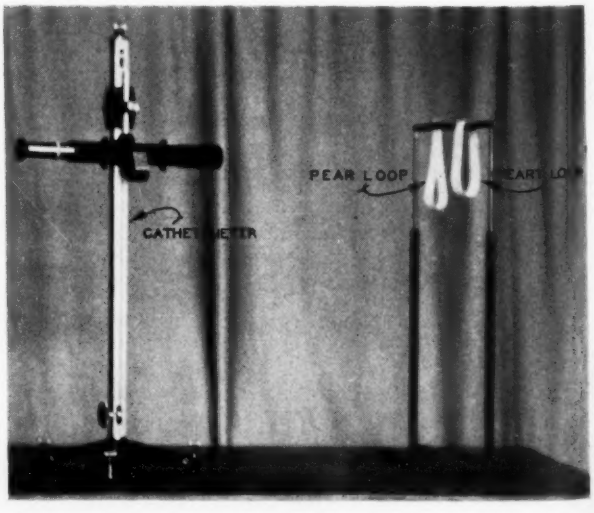
The hanging loop test as reported on by Peirce is fully described in the literature and reference has already been made to this in the first report of this series.* (See also Plate I)

The drape tester was developed at M.I.T. to measure a property which it is not believed has been measured by the other devices. Further details will follow on these latter methods. (See Plate II)

The test methods in general may be subdivided according as force is measured or as deformation is measured. The external force necessary to produce a known deforma-

*American Dyestuff Reporter, March 20, 1939, pp. 138. Textile Research, Vol. IX, No. 6, pp. 216-30 (1939).

Plate I



tion may be measured when the weight of the sample is acting as in the cantilever type of test for measuring the stiffness of yarn or fabric. External force to produce a known deformation may also be measured when the weight

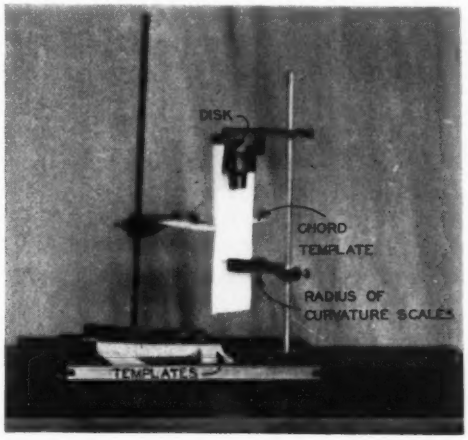


Plate II

is eliminated as is the case with the Schiefer flexometer where the sample weight is taken by the two vanes used in the instrument, or in the Saxl tester* where the weight is balanced out.

Where a deformation is measured, the deformation may be produced by the weight of the sample acting directly as in the cantilever test and in the hanging loop test or where the weight is acting indirectly as in the drape test. In the former instances the weight is acting to bend the sample directly about an axis while in the latter instance the weight is acting at right angles to the direction of the distortion. The distinction between "drape" and "flexibility" must be kept clearly in mind. The flexibility of a material is a general term which denotes either the deformation produced by a known force either external or from the sample itself as distinct from the drape of the material where the weight of the sample does not act directly to produce the deformation but rather has an influence on a deformation at some angle to its line of action.

MEASURABLE QUANTITIES

In this connection bending length, rigidity, bending modulus, drape length and corrected drape length are of importance.

The bending length is the length of sample necessary to produce a given deformation of the material under its own weight acting in the manner of a cantilever beam. The cantilever beam is distinct from other types in that it is supported only at one end. Two types of test were used in this investigation to determine the bending length. These were the heart loop (Plate I—right) and the pear loop (Plate I—left) respectively. The heart loop apparently has certain advantages over the pear loop which make it much to be preferred of the two lests. In the first place the formula for computing the bending length is much simpler for the heart loop than it is for the pear loop. The latter involves an experimental coefficient together with the cosine of a fractional part of the angle of deformation.** Previous work has indicated that the heart loop test was probably more satisfactory for materials which are extremely flexible than for materials which are extremely stiff. On the contrary, the pear loop was found to be more satisfactory for the stiffer materials rather than those which possess a high degree of flexibility. Under the cases so far investigated in this work it has been found that for a wide range of materials both as to thickness, hardness and stiffness that the heart loop could be used satisfactorily throughout. A further advantage of the heart loop is to be found in the fact that once a specimen length of sufficient magnitude has been determined any increase of the specimen length beyond this does not involve a change of bending length which is at all significant.

Reference to Fig. 1 will show the plot of specimen length against bending length for the pear loop and it will be seen that the resulting curve is closely approximated by a straight line. There is no place where the bending length remains constant over a range of specimen lengths. It would therefore be necessary to limit the length of the specimen of similar flexibility to a definite

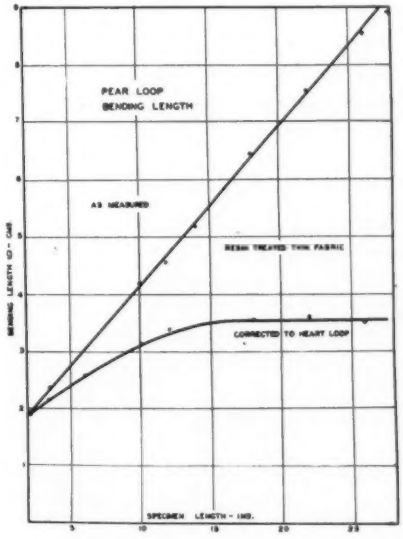


Fig. 1

value in order to have comparable results in the test. It will also be seen that if the proper conversion factors are used with the data for the pear loop test that the values may be corrected to those which would have been obtained

*Rayon Textile Monthly, January 1938, p. 57.

**Heart loop: $c = l_1 f_2 \frac{1}{4}$
Pear loop: $c = L(0.133) f_2 \Theta / \cos.0.87\Theta$

had a heart loop been employed. This curve will not agree exactly with the experimental ones but will be a reasonable approximation to it and ordinarily approximately parallel with it. Here it is found that beyond a critical length of specimen there is little if any change in the bending length for further increase of specimen length. Thus, any reasonable length beyond the minimum may be employed without affecting the final result. It should be apparent that the longer the specimen length, the longer the loop will be and hence the less precision of measurement is required for measuring the actual length of the loop. Thus much simpler and less expensive apparatus can be used for the heart loop test than is possible for the pear loop test. For comparison reference should be made to Fig. 2 which indicates for the series of ten fabrics investigated in this part of the work that the bending length remains substantially constant once a specimen length of some five to fifteen inches is reached. It should be noted that the stiffer materials call for a somewhat longer specimen length then do the more flexible fabrics. However, the sensitivity of bending length to change in specimen length is very much less and the

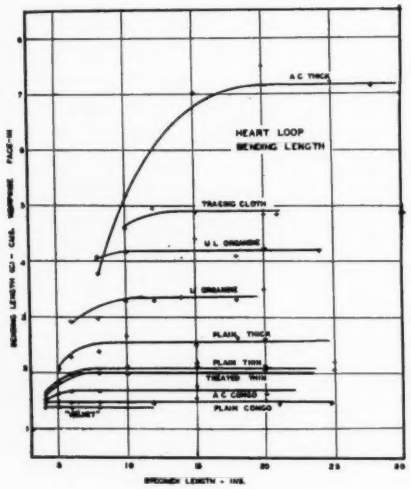


Fig. 2

operator is therefore allowed a much greater leeway in his investigation and a higher precision of measurement.

The rigidity of the sample is computed from the bending length by multiplying the cube of the bending length by the weight of the material per unit area. ($G = w. c^3$) Under these conditions the weight of the sample is taken into account and materials of differing weights can therefore be more satisfactorily compared. The rigidity is a direct measurement of the stiffness of the sample and compares well with measurements of the force necessary to deform the material. This is illustrated by the high Spearman rating (71%) from Table IV.

The bending modulus, on the other hand, is computed indirectly from the bending length by means of the rigidity. It is found by dividing twelve times the rigidity by the cube of the thickness ($q = \frac{12G}{d^3}$) and brings the thickness of the sample and consequently something of its softness or resilience into the picture. It tends to measure the paperiness of the material and a high bending modulus is apt to be an indication of a hard or harsh material.

THE DRAPE TEST

The drape length is the length of sample as supported on the drape tester measured from the top of the material to a point such that the length of the chord is a given constant value. The greater the drape length the more flexible the material will be. In order to correct for the affect of weight or determine what the drape length would be for a material of different weight assuming that they have the same stiffness we can relate the length as measured to the length desired by means of the weight per unit area of the sample which was measured and the weight per unit area of the sample whose drape length it is desired to determine. The formula takes the form:

$$H_c = L - \frac{W_m}{W_c}(L - H_m)$$

here H_c = the corrected drape length
L = the length of the specimen
H_m = the measured drape length

and W_m and W_c represent the weight per unit area of the sample measured and the weight per unit area of the sample whose properties are desired respectively.

In the drape test where the drape length is determined it is also possible to measure the contour of the lower edge of the specimen. (See Fig. 3) If this is a symmetrical curve it can be stated that the stresses set up in the sample are more or less uniformly distributed and therefore that the finishing operations (if any) have had a uniform effect. If fabric direct from the loom is subjected to the drape test it will be found—particularly for woolen and worsted materials—that the bottom edge of the sample

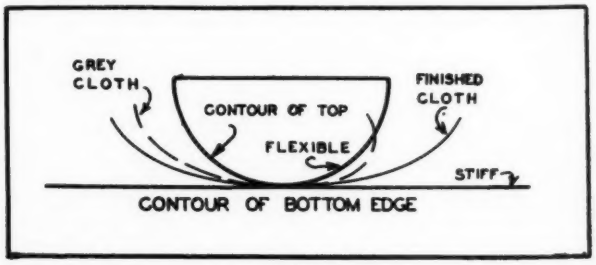


Fig. 3

assumes a non-symmetric shape. After proper treatment (usually wet finishing), if the finishing has been carried out properly, the curve becomes more or less symmetrical.

RADIUS OF CURVATURE

If the sample in the drape tester (See Plate II) has sufficient flexibility horizontally it will hang in such fash-

ion that when the top edge is deformed into a half circle by its attachment to the instrument, the bottom edge will likewise form itself into a semi-circle. The radius at the bottom edge or at any other point in the length of the specimen will therefore be constant and equal to the radius of the top circle. If, on the other hand, the horizontal stiffness of the material is such that any any given distance from the top of the sample or at the bottom edge of a given length sample the material takes the form of a substantially straight line, the fabric registers the maximum degree of stiffness. The radius of such a line is infinite in length and will decrease from this value rapidly to equal the radius of the circle at the upper edge of the specimen. Because the change is extremely rapid the measurement of radius of curvature becomes somewhat erratic as the bottom of the sample is approached—provided that the material has a reasonable degree of stiffness. It is believed, therefore, that the radius of curvature is not as satisfactory a means of comparing samples as is the chord length (to be described).

However, there may be times when the radius of curvature and its variation along the length of the sample may be of interest and value and it is computed from a knowledge of the length of a given chord and the distance of the center of the curve away from the center of this chord. The derivation of the formula for radius of curvature is derived as follows where it is assumed that r equals the radius of curvature desired, v is the distance of the curve from the chord at the center of the latter and c is the length of the chord itself. From simple geometry of the figure and from the usual relationship between the sides and hypothenuse of a right triangle we derive the expression

$$(r - v)^2 + \frac{c^2}{4} = r^2.$$

Simplifying we obtain

$$r = \frac{v^2 + \frac{c^2}{4}}{2v}$$

and in turn

$$r = \frac{4v^2 + c^2}{8v}$$

In the present form of drape tester (which is to be improved in design shortly) the radius of curvature is determined by means of two sliding scales graduated in millimeters, one of which follows along the center line of the disk to which the fabric is attached and the other is spaced a known distance from the first scale. This known distance is equal to $\frac{c}{2}$. It remains only to move the center scale slowly along a groove until the tip of the scale just touches the inner surface. The second scale is then pushed forward until it touches the surface of the fabric (Plate II—lower right) and the difference in the scale readings is noted and recorded as v. Since the value of c is known and the value of v can be measured at any desired distance from the top of the sample it becomes immediately possible by substitution in the formula just derived to obtain the radius of curvature at any distance from the upper edge of the sample. This radius of curvature will either remain constant for a material which is completely flexible and limp or will increase more rapidly as the stiffness of the sample increases. For comparison of samples it is therefore only necessary to determine a convenient distance from the top of the specimen at which all measurements will be made and to determine the radius of curvature at this point. The greater the radius of curvature, the greater the stiffness of the sample. Because of the rapid increase of radius of curvature for stiff samples as the bottom edge is approached, it is desirable that the distance from the top of the sample be made a small as value as can be done consistent with obtaining readings showing significant differences.

CHORD LENGTH

A somewhat more satisfactory technique is available and consists simply of measuring the width to which the sample spreads out as the measuring device is moved down from the upper edge of the specimen. Obviously this is an attempt to measure the length of the chord instead of the radius of curvature, on the assumption that the stiffer the sample the more rapidly will this width of sample or length of chord increase. Since this value does not approach infinity as one moves down the specimen but simply varies from the diameter of the circle to which the upper edge of the specimen is attached to the width of the sample which is equal to the semi-circumference of the top circle there is a steady and uniform increase rather than a sudden change. The curves which are obtained as a result of such tests are therefore somewhat smoother and the individual points lie closer to the curve than is the case with the radius of curvature measurements.

In the present drape tester the diameter of the disk to which the sample is attached is three inches. For simplicity of initial investigation a series of plates were prepared with rectangular openings cut from the long edge in such fashion that the length of this opening varied by ten per cent of three-inch intervals. This gave a series of increasing chord lengths, each unit of increase being ten per cent of the original diameter. A number of these templates were prepared and can be numbered in sequence as the opening at the side increases in dimension. These are successively laid on a platform attached to a vertical support on which it is free to slide vertically. (Plate II—left.) As the support is moved down the template may be brought toward the fabric and eventually the edges of the fabric will pass inside the opening at the edge of the

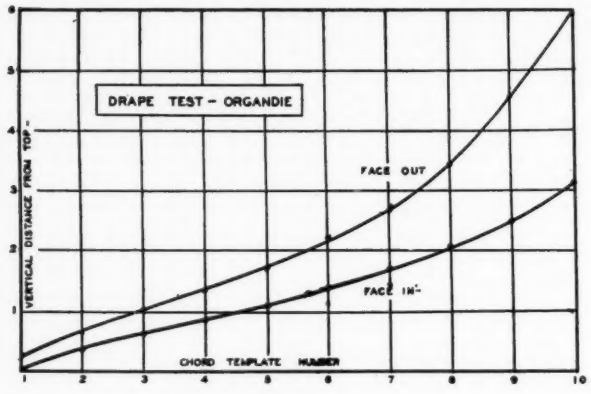


Fig. 4

template. The descent of the platform carrying the template is continued until both edges of the sample just touch the inner edges of the template opening. At this point the distance from the under side of the disk to the platform is measured and recorded as the drape length. It therefore becomes a simple matter to measure the drape length which corresponds to a series of chord lengths increasing by ten per cent increments of the original diameter. (See Fig. 4) If a certain sample shows a greater chord width at any particular height than another sample it is inferred that the first material is stiffer than the second. In similar fashion, if the drape length is less for one material than another the first material is thought to be stiffer than the second.

It will be apparent that the weight acting at any given height (for chord length measurements) will be the weight of the fabric below this level. If, therefore, the drape length be subtracted from the length of the sample we have the length of material acting to reduce the deformation. There will of course be a greater force the heavier the material is and in order to compare samples of different weights it is frequently desirable to be able to correct from one material to another on this basis. To do this the difference between the specimen length and the drape length for the sample being measured is multiplied by the weight per unit area of the material and this product is set equal to the difference between the length of the specimen which is known and the unknown drape length which it is desired to determine and this difference multiplied by the weight of the sample to which it is desired to correct. Solving this equation for the corrected drape length gives the expression which has been previously stated. It is believed that it may be possible to compare the effects of finishes in an interesting manner. If a given sample is measured and its drape length and its weight per unit area determined then it should be possible to determine the corrected drape length for a given chord length for a sample of some other weight. If now a sample of this weight be tested at the same chord length and a drape length differing from that computed is found, it is safe to infer, we believe, that the difference between the computed drape length and the measured drape length is probably due to the finishing treatment. A series of samples are now available which have been subjected to various types of finishing operations and it is proposed to carry through a series of drape tests on these materials and to supplement them by measurements made on various types of instruments for continued comparison of methods.

SPEARMAN'S RATING SYSTEM

In order to make comparisons between a series of materials which differ in stiffness or some other measurable property the Spearman Rating System to which reference has been made in the first of these series of reports will be employed. This rating takes the form of calculating the correlation coefficient for a series of ranked observations, that is, for observations which have been placed in some definite order of merit. Choosing, in this case the rigidity, as a desirable measurable quality the ten fabrics have been placed in order of decreasing stiffness (increasing flexibility) as the rigidity would indicate. The bending length, the bending modulus, and the results from various other tests have then been ranked in similar fashion. It would not be expected—because of the inherent variability of textile materials and because of experimental and other difficulties—that there would be perfect agreement between the various systems. This is particularly true inasmuch as different instruments measure slightly different characteristics of the fabric. However, by means of the Spearman rating (expressed in per cent) it is possible to judge the excellence of agreement between different sets of ranks. As an illustration of how the system works the reader should refer to Table III in which the ranks assigned to the various fabrics have been recorded and are based on the grand average of determinations with face of the fabric in, face of the fabric out, warpwise, fillingwise, etc. It will be seen immediately that the treated thick cotton fabric which was notably hard and stiff to the touch is rated first as to stiffness by all but one of the measuring techniques. The bending modulus is the measurement which takes into account the paperiness of the material and takes account also of the thickness of the sample. Thus, this measure places the tracing cloth first in stiffness because it is by far the most papery material of the series. It should also be noted that in four cases out of seven the "velvet" material which is notably the softest and also the most flexible of the series was placed at the end of the list. The readings in the body of the table are more or less irregular but on the whole when computed in the form of the Spearman rating they have some significant value. To obtain an idea of this result refer to Table IV which lists the Spearman rating of each method of measurement compared to every other for the series of ten fabrics and the series of measurements noted in Table III. The rigidity

TABLE III

Grand Average Ranks	*Bending Length*	*Flexural Rigidity*	*Bending Modulus*	*Schiefer Flexometer*	*Chord Length*	*Radius of Curvature*	*Gurley Tester*
Treated Thick Cotton	1	1	3	1	1	1	1
Plain Thick Cotton	5	3	8	3	2	2	2
Tracing Cloth	2	2	1	2	10	10	4
Unlaundered Organdie	3	4	2	6	4	3	9
Laundered Organdie	4	5	4	9	3	6	10
Treated Thin Cotton	6	9	6	4	8	7	8
Plain Thin Cotton.	7	8	5	7	9	9	7
A. C. Congo.....	8	6	7	5	7	5	3
Plain Congo	9	7	9	8	6	4	5
"Velvet"	10	10	10	10	5	8	6

TABLE IV

Spearman Rating (%)	*Gurley Tester*	*Radius of Curvature*	*Chord Length*	*Schiefer Flexometer*	*Bending Modulus*	*Rigidity*
Bending Length .	12	27	29	69	88	86
Rigidity	48	48	42	71	65	—
Bending Modulus.	—15	—6	—9	49	—	
Schiefer Flexometer ...	64	30	4	—		
Chord Length ...	20	83	—			
Radius of Curvature	38	—				

was computed directly from the bending length and it would therefore be expected that there should be a high degree of relationship between these values. Inspection of Table IV indicates that a Spearman rating of 86 per cent is to be found and a rating of 88 per cent between the bending length and the bending modulus. It would not be expected in normally variable textiles that as high a Spearman rating as this would be obtained for measurements which are to be related only by physical tests and not by mathematical computation. It is not surprising, therefore, to find values in the table ranging from 30 to 60 per cent.

Certain of the values in Table IV will be noted to be negative and the significance of this should be pointed out. Reference to Table V which gives the method of computing the Spearman rating in detail for three possible cases will clear this matter up. The Spearman formula is noted at the top of Table V and the first case indicates the ranking of sample series "A" with sample series "B." Here it will

TABLE V

Spearman Rating

Formula: $\rho = 1 - \frac{6\Sigma d^2}{N(N^2-1)}$

Case 1

A	B	d	d^2
1	1	0	0
2	2	0	0
3	3	0	0
4	4	0	0
5	5	0	0
			$\Sigma d^2 = 0$

$$\rho = 1 - \frac{0}{5(24)} = 1 - 0 = +1$$

Case 2

A	B	d	d^2
1	5	4	16
2	1	1	1
3	2	1	1
4	3	1	1
5	4	1	1
			$\Sigma d^2 = 20$

$$\rho = 1 - \frac{120}{5(24)} = 1 - \frac{120}{120} = 1 - 1 = 0$$

Case 3

A	B	d	d^2
1	5	4	16
2	4	2	4
3	3	0	0
4	2	2	4
5	1	4	16
			$\Sigma d^2 = 40$

$$\rho = 1 - \frac{6(40)}{5(24)} = 1 - \frac{240}{120} = 1 - 2 = -1$$

be seen that both are ranked identically and that the difference between the values in column "A" and column "B" is zero in each case as is the square of each of these differences. Substitution of the sum of the squares of the differences in the formula together with the number of items in each rank (N) gives us +1 as the rating. In terms of per cent this would be 100 per cent and would indicate perfect agreement.

Case 2 of Table V indicates a ranking in numerical order for series of specimens "A" and a different ranking in the case of specimen series "B." The difference between the columns "A" and "B" is indicated together with the square of the differences and the sum of the squares of the differences and when this is substituted into the formula we arrive at a Spearman rating of zero which indicates that there is no agreement between the two rating systems.

Case 3 of Table V indicates that the ranking in series "A" is opposite to the ranking in series "B" and the differences, squares of differences and the substitution of the sum of the squares of the differences into the formula gives us a Spearman rating of —1 (or —100 per cent). This would indicate that there is a reverse relationship

between the ranking and that while one series shows an increase of a certain property the other shows an exactly corresponding decrease of this property.

It will be noted that in the Spearman Rating Table (Table IV) the negative values are small and it is doubtful at this time and because of the small number of samples tested that these are significant. It may be, however, that they indicate a reverse trend and this tendency will bear further investigation. It should be noted that it is the bending modulus which has this reverse rating and that this is the item in which we are likely to find the greatest amount of interest in interpretation of results—comparing them with such things as bending length, rigidity, and force to deform.

It must be emphasized that Tables III and IV simply show trends developed by the testing of a series of randomly selected fabrics and that they are not to be taken as final comparisons between methods. The method of use of this rating system is important enough to warrant the discussion with which the latter part of this paper has been occupied and the method will be used in future papers, thus it is believed wise to give a more detailed explanation of it at this time than might otherwise seem warranted. The reader is cautioned to avoid drawing too definite conclusions from the data thus far presented. He is warranted, however, in noting the fact that the various techniques which have been employed have one thing outstandingly in common. They are measuring in each case differences in flexibility which are very difficult to determine in any ordinary way. One of the outstanding advantages—as shown from the present series of tests—in the drape test method is that it is probably the most sensitive of the entire series. Thus far it appears to be the only method of measurement which will satisfactorily and consistently distinguish between bending of the fabric with the face toward the concave side and with the face toward the convex side respectively. (See Fig. 4) The differences of flexibility warpwise and fillingwise are marked enough to be indicated by any of the methods but when slight differences of finish on the face as opposed to the back of the fabric are to be detected it seems that the drape test has decided possibilities. For this reason the drape tester is to be redesigned and rebuilt in more convenient and versatile form and will undoubtedly be mounted as a single unit and also as a multiple set so that convenient comparisons may be rapidly made between specimens of different properties. It is felt that the test is simple enough and inexpensive enough to construct and operate so that it should appeal to persons in the textile industry for whom flexibility of fabric is an important item. It is hoped, therefore, that the simplicity and ease of operation of the test will commend itself to these individuals and that they will have opportunity to carry out further tests and to so accumulate a large amount of data which can then be discussed and correlated to the mutual benefit of the industry at large.

Identification

of the Newer Textile Fibers*

JOHN H. SKINKLE**

THE new fibers which I am going to consider are the ones that are actually new from the standpoint of composition, rather than fibers which vary from already established fibers simply by a difference in physical properties, such as adding crimp to rayon, but which do not essentially change the composition of the fiber. These will include glass fiber, casein wool, mixtures of viscose and casein of the cisalfa type, our old friend nylon, and vinyl resin type.

Before we go into the systematic identification, I would like to say a few words about the general chemical properties.

All of these were as we found them, because, being new fibers, they will undoubtedly vary as modifications are made in manufacturing methods.

The glass fibers were insoluble in all the solvents we tested, non-inflammable, and the distinguishing feature which separated them from asbestos was the melting point.

The casein wool had all of the reactions of wool, with the exception of the fact that it was more resistant to alkalis, and therefore the distinguishing reaction is the reaction with cold, strong caustic.

The viscose-casein mixture was distinguished by the fact that it has the color reactions of casein and the solubility reactions of viscose.

Since most of our tests, of course, are preferably of the

*Presented at Annual Meeting, Boston, Mass., September 15, 1939.

**Lowell Textile Institute.

solubility type so that we may carry them out on dyed fibers, that means that we will have to distinguish it from the viscose.

The nylon had none of the reactions of ordinary fibers, but it is distinguished by the fact that it is soluble in melted phenol and none of the other fibers are soluble in that reagent, with the exception of acetate rayon which however is soluble in acetone while the nylon is not

The vinyl resin type has none of the ordinary reactions, except that it is soluble in acetone, in which case it is like the acetate rayon, but it is not soluble in glacial acetic acid in which the acetate rayon is soluble.

Microscopically, we find that the glass fiber resembles asbestos, and also, to some extent, cupra. Microscopically, the casein wool resembles both acetate and viscose in that it is more striated than the acetate rayon and less striated than the viscose. It would be, therefore, rather difficult to separate it from either of those fibers.

The cisalfa type—that is, the viscose-casein mixture—resembles viscose.

The nylon looks very much like cupra and in polarized light is very strongly doubly refractive.

The vinyl-resin type has some striations in which it resembles viscose, but it is not doubly refractive. Vinyl-resin, incidentally, shows an extremely high shrinkage the minute it is placed in any hot solution. The shrinkage amounts to seventy-five or eighty per cent. It rolls up into a little ball, so it doesn't give us much trouble.

Now for the chemical separation of all the fibers, including these new fibers. We have boiled down a mass of different tests to eleven which seem to perform fairly satisfactorily.

The simplest, of course, is the burning test. We have all seen that used, usually to tell whether there was any wool in the mixture from the odor.

As it happens, I had my sense of smell destroyed some years ago by a laboratory reaction, so that it is of no use to me. In any burning tests I must depend entirely on visual effects.

I divide the results of the burning test into three classes: First, those fibers which do not burn, which includes asbestos and glass fibers; second, those fibers which burn but leave a residue of the same shape and size as the original fiber (that, of course, is weighted silk); third, those fibers which burn with or without an odor.

To the first group—those which do not burn—we apply the melting test. The heat of the ordinary Bunsen burner is not sufficient to melt asbestos, but it will melt glass. Consequently, we have two divisions here: Those fibers which melt (which are glass) and those which do not melt (which are asbestos).

The third test is the old five per cent KOH test, applied to those fibers which burn with or without odor. That divides the fibers into two groups: Those which are soluble (hairs, casein wool, and silks) and those which are insoluble (other kinds).

Taking those fibers which are soluble in KOH, we apply the fourth test—cold, concentrated hydrochloric acid. The hairs and casein wool are insoluble.

To separate the hairs and the casein wool, we use the fifth test—twenty per cent sodium hydroxide for three hours at 30° C. The hairs are soluble and the casein wool is insoluble.

The sixth test is applied to those fibers which are not soluble in KOH. This is the acetone test. That divides the fibers into two groups: Those which are soluble (acetate and vinyl) and those which are insoluble (other fibers).

The seventh test is the application of cold, glacial acetic acid applied to those fibers which are soluble in acetone. That divides it into two groups: Acetate rayon (soluble) and vinyl-resin (insoluble).

The eighth test is the melted phenol test. We take some crystalline phenol (or carbolic acid) and heat it until it melts, which is at about forty degrees Centigrade, and place the fiber in it. The nylon is soluble and the other fibers are insoluble. Remember that acetate rayon would be soluble, but it has already been determined at this point, so it doesn't interfere with the test.

The ninth test is a color reaction, but it is applicable to a stripped fiber—that is, if the fiber is dyed we can strip the dye and then test with the zinc chloride-iodine solution. This test gives a blue color with mercerized cotton, cupra, viscose, and cisalfa, and no color with cotton, jute, hemp, and flax.

That is as far as we can go on a dyed sample by chemical tests; it is impossible to go any further.

If the fiber is not dyed, however, there are two further tests that may be applied. The fibers which give a blue color with the zinc chloride-iodine agent may be tested with Millon's agent. Cisalfa gives a red color at this point. The mercerized cotton, cupra, and viscose do not.

The eleventh test is the aniline sulfate test. It may be applied to fibers which are not colored by zinc chloride-iodine, and we find that jute and hemp give a yellow color, whereas cotton, flax, and ramie give no color.

That is as far as we can go chemically. Some of the fibers, acetate, rayon, etc., may be positively identified. There are, however, left a few groups.

In the first place we have the hairs which cannot be chemically separated, but which must be identified microscopically. We have the silks in one group. Microscopically, of course, their identification is easy. Then in another group we have mercerized cotton, cupra, and viscose. They can be identified, also, microscopically. Finally, we have in the last group, cotton, flax, and ramie, which can be microscopically identified.

Progress in Textile Research

from the Consumer Point of View*,[1]

PAULINE BEERY MACK**

THEORETICALLY, all research work in the field of textiles is of interest to the ultimate consumer, since it will affect the product which is offered on the market in some way or another. The present discussion, however, will be restricted to research studies on textiles which have been planned and carried out distinctly from the consumer point of view.

Consumer studies in the textile fabric field have taken a number of directions, which may be summarized briefly thus:

1. Accuracy of sales information secured by the ultimate consumer on the retail market.
2. Performance of fabrics secured on the retail market: (a) as judged by laboratory tests; (b) as judged by wearing tests.
3. Technical studies on the relationship of fabric performance to fabric construction, including fiber composition, fabric construction, and chemical composition of the dye.

The choice of field in which a certain laboratory works is determined by the purpose for which the laboratory was established, the availability of equipment, and numerous other considerations. In the various colleges and universities in which work in this field is prosecuted, the curriculum in which graduate students engaged in the work, or the departments to which staff members are attached are determining factors in the trend taken by the research studies in textiles which may be carried on in the laboratories in question.

A few examples from each of these main lines of work will serve to illustrate their general character. These examples are chosen principally from work with which the author has been associated, because of her greater familiarity therewith.

Perhaps the most comprehensive series of studies on the accuracy of sales information concerning any group of textile fabrics, and on their performance was that conducted at The Pennsylvania State College from 1930 to 1937 on silk and rayon. A number of other colleges and universities collaborated in some units of this research series. The results of this have just been published in a 220-page bulletin under the title of "Resumé of an Eight-Year Series of Consumer Studies on Silk and Rayon," Home Economics Research Series Publication Number 3[2].

*Presented at Annual Meeting, Boston, Mass., September 15, 1939.

**The Pennsylvania State College.

The following summary, abstracted from this report, serves to show the field covered in this group of studies in question and the trends in accuracy of sales information on silk and rayon which were found through the period of time which was covered.

When these studies were begun, no generally accepted basis of calculating silk weighting prevailed in the silk trade. Practically all manufacturers failed to consider mineral weighting up to 18 to 20 per cent of the finished weight of the fabric as weighting, because they claimed that this merely replaced the sericin, or soluble silk gum which have been removed during the boiling-off process. Manufacturers differed widely from each other in their methods of calculating weighting, aside from the one point of beginning to calculate weighting only after the gum had been removed during finishing.

As a result of numerous manufacturer-retailer-consumer conferences held under the auspices of the Better Business Bureau when the early studies in this series were in progress, a standard method of calculating and reporting weighting was agreed upon, with the finished fabric regarded as 100 per cent, and any part of this being found not to be silk fibroin regarded as dressing and weighting.

In the studies reported in the first three papers of the series under consideration by Winning and Mack, Mack and Winning, and Cook and Mack, a random sample of fifty silk dresses at a wide range of prices was bought in 1930 on the largest retail dress market in this country—New York City. By these studies it was shown that style and appearance seemed to be given more attention than weighting in the fabrics, or fabric durability. Whereas the average amounts of weighting in the fabrics were less for the dresses bought for more than $20 than for dresses costing this amount or less, there were a sufficient number of individual exceptions to this finding to make price an unreliable criterion for judging the weighting content. Only 4 per cent of the dresses were properly described at the time of sale as to weighting content, and a still lower percentage of accuracy was obtained concerning the durability of the fabrics. Only 6 per cent of the dresses were made of unweighted silk, and this proportion was confirmed by confidential trade sources as being representative of the market at the time. The unweighted fabrics in these three studies were definitely established as more durable than the weighted ones.

In 1931-1932, in a study reported in Paper Number 4 of this series on testing silk for college girls' uniforms, it was found that 26.6 per cent of the information given

concerning the weighting content of the silk fabrics submitted was accurate. The increase in accuracy over the findings of one and one-half to two years earlier may have been the result of a considerable amount of consumer pressure for more accurate information concerning the amount of weighting in silk, or it more likely was influenced by the fact that the fabrics sent to the laboratory were submitted as meeting certain specifications. In this case a technically trained person dealt with a manufacturer through a retailer when a specific set of characteristics in silk were sought, rather than a private consumer with the ordinary sales person in the usual course of retail purchasing. Even so 26.6 per cent of accuracy was not high.

In 1932, the Federal Trade Commission defined legally the terms "Pure Dye" silk and "Weighted Silk." According to this ruling, silk, if described on labels or in any other manner in the course of a sale of this commodity, must be labeled to conform to the definitions in question. Labelling was not mandatory; but conformity with the definitions was mandatory if the silk was labeled or otherwise described.

From 1932 to 1934, silk underslips were sampled on the market, and tested in a study described in Paper Number 5. In this study it was found that the label "pure dye silk" invariably accompanied a slip of which the silk conformed to the Federal Trade Commission definition of this term. Such terms as "All Silk," and "100 per cent pure silk," however, were found on labels attached to slips made of heavily weighted silk. In tracing some of these labels to their source, the author found that the manufacturers felt no obligation in safeguarding the use of any save the "pure dye silk" label.

In an investigation of silk yard goods on the retail market made in 1934-1935, Paper Number 6, silk fabrics were purchased in the same manner as might be followed by any retail consumer. In this study 55 per cent accuracy of the answers received concerning the weighting content of yard goods was 35 per cent. The manner in which this study was carried on was comparable with that of the earlier study of fifty silk dresses. An improvement of from 4 to 35 per cent was found, therefore, during the period from 1930 to 1935. Undoubtedly the Federal Trade Commission ruling together with an increasing popular demand for correct information were important contributing causes of this increase in reliability of sales information concerning weighting in silk fabrics. Ideal market conditions could not be said to have been reached as yet, however, in view of the fact that a consumer's chances of receiving correct information about this important point were about one in three. In this study the continued presence of labels and placards worded "all silk," "pure silk," and other perversions of the legal term "pure dye silk" were found to be used on heavily weighted silk.

A survey of the opinions of 37,785 women by Edna Gray of the University of Illinois and the author made from 1930 to 1933, described in Paper Number 7 of this series, revealed the fact that women want correct information about silk fabrics and dresses even though they might not necessarily want long wearing fabrics in every case. The survey showed merely that the great majority of women want to know what they are getting at the time of purchase.

A study of 100 discarded silk dresses described in Paper Number 8 of this series, showed again that the cost of silk dresses is no guarantee of their durability, and that their chief cause of low durability is the presence of large amounts of mineral weighting. Other factors also serve as causes of low durability.

As reported in Paper Number 9 of this series, a group of 100 consumers was found to be unable to judge silk fabrics properly as to weighting content or durability. Another group of 100 persons, fifty of them technically trained to some extent in the field of textiles and fifty not so trained, was found to judge silk fabrics as to weighting content and durability no better than did the random group. The judgments of the trained sub-group were no more accurate than were those of the untrained group, although their errors were on the side of rating the fabrics too high as to weighting content and too low as to durability, while the untrained sub-group erred in the opposite direction.

While the copy for this series of reports was in printer's proof, a new group of Trade Practice Rules was promulgated by the Federal Trade Commission (November 4, 1938). According to this ruling, the labeling of silk is mandatory, and the terms "pure silk," "all silk," and other words of like import are placed in the same category as "pure dye silk," and may not be used unless the fabric in question conforms to the legal definition thereof.

While work on unweighted and weighted silks was in progress in the laboratory, the ever-increasing importance of rayon in women's wearing apparel was not disregarded. Preliminary work on rayon was begun on this subject in the laboratory of the author in 1924, although no graduate research problem was chosen on this fabric until 1934. A study described in Paper Number 10 of the series was made as part of a dissertation from 1934-1936, in which eighty-two rayon fabrics were obtained from manufacturers. In the absence of standardized techniques for the purpose, tests for wet breaking strength and for seam slippage were devised and applied, together with other tests, to the fabrics in the study. The need for standard tests of these two characteristics was demonstrated. The loss in strength from wetting was found to be greater in rayons than in silks, although the latter show some losses when wet, even when they are not weighted. Seam slippage was found to be greater in the rayon fabrics than in the fabrics made of natural fibers.

In 1936 and 1937, a study presented in Paper Number 11 of this series, was carried on with 100 rayon fabrics bought at random on the retail market. In this study, 45.75 per cent of accuracy on the average characterized the answers to 800 questions asked during the course of the 100 purchases. The highest degree of accuracy was on fiber content; the lowest on durability, including launderability and dry cleanability. The study showed the need for better information for the consumer particularly with respect to the performance of rayon during wear, and to the care of these fabrics.

In 1936 and 1937, a study of 100 discarded rayon dresses was made. This study, which is given as Paper Number 12 of this series, showed that a standard test for measuring seam slippage proposed since the study of Paper Number 10 was completed was not sufficiently rigorous to predict seam slippage in actual use accurately. Low strength, reduced strength of rayon when wet, and lack of color-fastness were included among the causes for discarding the dresses.

In Paper Number 13 of this series on color-fastness of silks, light wools, rayons, and mixed fabrics, the need for further standardization of methods for testing the fastness of dyes from the consumer's point of view, and the need of faster dyes on fabrics of these types are revealed.

As this series of studies was concluded, a Federal Trade Commission ruling making the correct labeling of rayon fabrics as to fiber content mandatory was passed during the latter part of 1937.

While the series of studies on silk and rayon just summarized was still in progress a cooperative project of the Northeastern Experiment Stations on the "Durability of Women's and Children's Silk, Rayon, Cotton, and Wool Wearing Apparel Fabrics" was begun, with experiment stations in Maryland, New Hampshire, New Jersey, New York, Pennsylvania, and Rhode Island participating. In this project, which has been described in the Journal of Home Economics[3], hundreds of fabrics are being collected from consumers in the participating states.

Extensive laboratory tests are made on each new fabric, wearing records are kept by the owner under the direction of a textile person associated with the project, and the garment is examined when it is considered no longer wearable by the original owner. The accuracy of the sales information is judged; the laboratory and wearing performances are compared; and the satisfaction of the consumer with the performance is ascertained. The repeated appearance of the same or similar fabrics in the study enables numerous checks on wearing records to be had.

A mass of information is being accumulated in this project on the characteristics of the fabrics on the market, the ability of the present laboratory tests to predict wearing performance, and the reasons for discarding garments by their wearers. Such individual subjects as incidence of shrinkage of launderable and drycleanable fabrics on the present-day market, recently reported in the AMERICAN DYESTUFF REPORTER[4], the color-fastness of fabrics, and the strength of fabrics may be considered from a large accumulation of laboratory consumer data, such as is afforded by this type of cooperative project.

The household textile field is not being ignored by those interested in textiles from the consumer point of view. A recent study on upholstery fabrics recently published by the Bureau of Home Economics[5], and another study in the same field made at the Pennsylvania State College[6] on mohair pile fabrics used for upholstery purposes both show the need (1) of further work on standardizing the methods of testing this type of fabric; and (2) of better sales information to the ultimate consumer on the performance of this type of fabric.

A recent study carried on at the Pennsylvania State College[7] on drapery fabrics has shown that price is not an infallible criterion in selecting drapery textiles, and that sales information concerning the performance of this type of textile commodity is, in the main, not accurate.

The finishes used on textile fabrics to impart special characteristics, such as crease-resistance and water-repellency, have been considered in a recent graduate study at the Pennsylvania State College[8]. This has shown that supposedly crease-resistant fabrics obtained in 1938-9 gave much better performance, both with respect to crease-resistant properties and durability than those secured one year earlier in 1937-8. Fabrics having these finishes are not labeled or described, however, in a manner which is helpful to the consumer in making selections. Supposedly water-repellent fabrics secured from 1937 to 1939 were not shown to conform to any standards which have been tentatively proposed for this type of fabric, and a great need for standardization in this field has been shown.

An accelerated ageing test which will enable the long-time performance of a textile fabric to be predicted within a short time has long been recognized. In addition, this type of approach enables the combined effect of more than one ageing influence to be studied. Notable work in this field has been done at the Bureau of Standards[9]. Recently, a cooperative study carried on by the Bureau of Standards and the author's laboratory has demonstrated the advisability of this type of test as a basis for performance labeling of textile fabrics—a type of labeling which would be of extremely great value both to the consumer of textiles, and to the manufacturer of textile merchandise who wishes to sell his product on its merits. This new work on an accelerated ageing test for fabrics will be reported in detail at an early time.

In considering the performance of textile fabrics in the various studies which have been cited, the need for serious attention to launderability and drycleanability has been

demonstrated. Unless a fabric can be refreshed either by laundering or drycleaning, it has but passing value to the consumers, retailers, and launderers or drycleaners. If a fabric has been found to perform unsatisfactorily during laundering, some stores have been found to recommend that this class of fabrics, and all articles made from it, be drycleaned—and this without regard for whether or not the fabric is drycleanable. A recent case in point unearthed by one of the consumer textile studies with which the author is associated was that of a reputable department store which recommended that all furniture covers be drycleaned, not laundered. The study in question showed that many of the furniture cover fabrics vended by this store performed with equally unsatisfactory results during drycleaning.

A point which is frequently ignored in studies related to the performance of textile fabrics during drycleaning is the fact that the drycleaner must use water in some parts of his process, or else he finds himself considerably restricted in the types of stains and soil which he may remove. In general, fabrics have been found in various of the studies cited to perform much better in the tests of drycleaning by the dry than of drycleaning by the wet method. Those interested in manufacturing fabrics which are to be drycleaned satisfactorily can well give attention to this point.

Recent consumer studies have shown the serious need for better cooperation between manufacturers of fabrics and of ready-made garments and leaders in the laundry and drycleaning field, in order to produce durable textile fabrics and ready-made commodities. Shrinkage, colorfading and color-changing frequently take place while an article is in the launderer's or drycleaner's possession, although the fault lies inherently in the fabric itself, or in the unwise choice of dye used upon it. In connection with the latter, there are many dyes now used which change color with small changes in pH, and which give dissatisfaction on this account during wear and cleaning. Many of these are little more permanent in shade than litmus, used by every elementary chemistry student in exercises on acids and bases.

Although much of the consumer work in textiles during the past 10 years has been directed toward finding the degree of correct information obtainable on the market, the incidence of shrinkage and color-fastness of fabrics, and other performance results, a new note has recently been injected into studies of this type—namely, investigations of the relationship between the construction of fabrics and their durability, and between the chemical structure of dyes and their color-fastness under various conditions. All fabrics now received in the Northeastern Regional Experiment Station[3] project are analyzed as to construction and as to chemical type of dye present. In other individual studies in progress in the author's laboratory, the same technique is followed, and statistical comparisons are being made between such factors as the construction of a fabric and its strength and shrinkage, and between dye types and color-fastness.

It is the hope of those engaged in the type of research studies discussed in this report that the results obtained may be of value in the manufacture and labeling of fabrics from the point of view of the ultimate consumer.

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Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary or the American Dyestuff Reporter any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

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To Prospective Employers

Complete personal histories and employment records of the following applicants are now on file at the office of the American Dyestuff Reporter and with the secretary of the Association. These may be examined by prospective employers or copies will be loaned upon application.

A-B-7

Education—Evening school in textile dyeing and chemistry.
Experience—Dyehouse laboratory for 2 years. Foreman dyer and finisher on hosiery for 9 years. Experience on ribbons also at dyes on rayon and silk skeins. 2 years assistant to superintendent. Desires position either in demonstrating and sales or dyer; New York Viciniy. Age 33; married.

A-B-8

Education—Graduate Chemist.
Experience—Print superintendent, colorist; eleven years' experience in all types of fabrics, specializing on rayon; 8 years' dyestuff laboratory and demonstrating. Excellent references; age 36; married.

A-B-9

Education—Bradford Durfee Textile School, 1918, chemistry and dyeing course.
Experience—Dye application, textile and color chemist; good general factory, laboratory and office experience; accustomed to assuming responsibility; handled all types of help; purchased chemicals, dyes, etc.; executive ability; good personality.
Age 42; American, married; will go anywhere for interesting work; references.

A-B-10

Education—1 year of textile chemistry, day course, Philadelphia Textile School; also business course.
Experience—3 years as apprentice in weaving mill in Germany, office and stock room, general clerical work, practice in all departments of cotton manufacture, dyeing, bleaching and finishing of cotton-rayon mixtures, piece and package processing; several mos. in laboratory of German dyestuff manufacturer, dyestuffs and assistants and their application, vat and naphthol dyeing.
Age 20; will go anywhere in U. S.

A-B-11

Education: Graduate chemist. Correspond and converse German, some French.
Experience: 3 years dyer; 4 years dyestuff testing, trouble-shooting, purchasing; 4 years demonstrating, consulting, and supervising for large dyestuff manufacturer. Thoroughly experienced on rayon, cotton, silk, acetates, printing, vats. Fullest references as to character and ability. Seeks position as technician, consultant, or superintendent with reliable dyestuff sales organization or dyehouse. Age 33, married.

A-B-C-4

Education—Educated abroad.
Experience—Twenty years experience in the textile field as bleacher, dyer, finisher and chemist. 16 years in charge of dyestuff laboratory of large dyeing plant, 4 years as chief chemist with large bleachery. Has tested dyestuffs, and chemicals used in the textile field and has manufactured soaps and textile specialties. Has handled all textile fibers; bleaching, printing, dyeing and finishing same. Has done pigment and lacquer printing, waterproofing and fireproofing. Reason for leaving last position was due to business conditions.
Age 41; married.

A-B-C-6

Education—English Municipal School of Technology; Board of Education, So. Kensington Chemistry Certificates; City & Guilds of London Institute in Bleaching and Dyeing.
Experience—In U. S. A. 22 years as chemist and chief chemist with one of the largest textile plants in the country; expert colorist; long experience with permanent and semi-permanent finishes. Specialist on vats, naphthols and indigosols. Age 50; married.

A-B-C-7

Education—B.S. in Textile Chemistry and Dyeing, 1939, North Carolina State College.

Experience—None. Seeks position as textile chemist and colorist. Age 21; single.

A-B-C-8

Education—B.T.C., 1933, Lowell Textile Institute.

Experience—5 months as rayon slasher tender; 8 months color matching, dye testing and analytical work; 5 years with large print works in rayon finishing department, laboratory, color matching, dye testing, assistant rayon dyer. Seeks position as rayon dyer, assistant dyer, or any job in a rayon dyeing and finishing plant. Age 29; single.

A-B-C-9

Education—Lowell Textile Institute; chemistry, dyeing and textile finishing.

Experience—Twelve years head dyer in hosiery mills. Dyeing all types of fibers and in combination. Knowledge of all dye applications. Matching and formula making. Charge of every department in a hosiery mill except fixing machinery. Has done jigg work on cottons and rayons. Desires position in hosiery, or in any field. Would like to work as an assistant to head dyer in a woolen or rayon mill. Age 42; married. Will go anywhere in the United States.

A-B-C-D-1

Education—Lowell Textile Institute, Bachelor of Textile Chemistry; Lowell Textile Institute (Evenings), 2 years D. C. Electricity; 2 years A. C. Electricity.

Experience—Six years as chemist and assistant dyer with a large organization. Specialized in dyeing, finishing, bleaching and drying of woolens, worsteds, cottons, rayons and unions in the piece. Some sales experience. Desires position as chemist, dyer, finisher, bleacher or sales. Age 30; American citizen; Married.

A-B-C-F-1

Education—Textile Institute course in Dyeing and Chemistry; Extension work at Brown University; Executive Training with Alexander Hamilton Institute of New York, N. Y.; working knowledge of one foreign language.

Experience—Dyeing executive on all types of textiles including stock, yarns in the skein, warp and package, and piece goods. Thorough knowledge of all classes of dyes and dyestuffs and their successful practical application in the plant. Extensive knowledge of all types and makes of equipment for dyeing, bleaching, mercerizing and finishing. Laboratory practice in testing, standardizing, purchasing, costing, planning and checking processes, and market analysis. Good manager of personnel for better efficiency in retaining friendly labor relations. Conversant with modern methods for quality production economically secured through better coordination and correct alignment in processing, on cotton, viscose and acetate rayon, silk, wool, worsted, and mixtures. In excellent mental and physical health; excellent references.

A-B-C-F-2

Education—Lowell Textile Institute, 1911.

Experience—26 years in cotton yarn and piece goods finishing plants; expert on naphthols, vats and other cotton and rayon dyeing; all types of control work and testing; analytical processes; purchasing of dyes and chemicals. Age 46; excellent references; in perfect health; will go anywhere; married.

B-5

Education—High School and Textile School Graduate.

Experience—Twelve years overseer of dyeing on directs, vats, naphthols, sulfur, basic and developed colors. Also experienced bleacher. Age 40; married; references.

B-C-3

Education—Graduate, Philadelphia Textile School; speaks German fluently.

Experience—Employed at velvet company for 7½ years. Past 2 years working in finishing department on regular, waterproof and crush-resistant finishes (resin finishes). Can take charge of finishing of velvets. Have some piece dyeing experience.

29 years of age; married; will go anywhere.

B-D-1

Education—General education in England. Chemistry and Dyeing Courses at Huddersfield Technical School.

Experience—Has been a superintendent of dyeing since 1911. Has had experience in worsted mills, hosiery mills and woolen mills. Congenial, sober and reliable. Married; references; age 53.

F-1

Education—Two years high school; 6 years evening engineering school; 1 year evening textile school; 1 year industrial management; course in accounting.

Experience—Ten years in an executive capacity in full fashioned hosiery manufacturing business. Familiar with entire manufacturing procedure, finishing dept., dyehouse and office. Specialized in finishing dept. and has good eye for color, finish and quality. Had responsibility of all orders going through mill, stock, grey goods and traffic. Five months in New York sales office. Gets along well with people and contact with employees and customers has always been satisfactory. Previous to hosiery experience was in a mechanical business for 17 years.

43 years of age; single, in good health; will go anywhere.

The Textile Institute—

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to high heats. Strangely, it is quite susceptible to mechanical damage when wet. The principal present uses of glass fiber are for electrical insulation and for chemical filtration; the fiber has not yet been successfully used in the domestic and fashion fields.

"Casein Fiber" by G. Heim and "Manufacture and Properties of Casein Fiber" by C. Diamond and R. L. Wormell will be abstracted as one paper since practically the same fields were covered by both papers. The raw material for this fiber is the casein obtained from skim milk by precipitation with acid; the dried powder is dissolved in dilute sodium hydroxide and is extruded through fine holes into the coagulating bath of dilute acid; since the casein is soluble in dilute acid as well as in alkali a high concentration of salts must also be present in the coagulating bath. If the casein fiber is left in this form it is very susceptible to both water and the acids used in dyeing, therefore a hardening process is necessary beginning at the coagulating bath; this hardening may be accomplished by means of formaldehyde or aluminum salts or both. Casein possesses a high proportion of glutamic acid and lysine residues (three times as much lysine and twice as much glutamic acid as wool) and so it is believed that in the precipitation of the casein a large number of salt linkages are formed which make for a long chain length in the fiber; salt linkages however are weakened in the presence of water and are sensitive to pH's on either side of the neutral point and so the casein which is not hardened is sensitive to water, acids, and alkalies. In the presence of formaldehyde, it is thought, methylene bonds are formed according to the equation:

$$H_2N- + HCHO + -NH_2 = -NH-CH_2-NH- + H_2O$$

Spun with no formaldehyde, the casein wool is brittle and has practically no strength, this corresponds to a short chain length; spun into a formaldehyde bath, coupling occurs with an increase in the effective chain length; the methylene bond is therefore analogous to the disulfide bond in wool. The methylene bond, however, is more resistant to alkali than the disulfide bond which accounts for the increased resistance of casein wool to 20 per cent sodium hydroxide in the analysis of wool-casein mixtures. Formaldehyde treated casein is made more insoluble by a heat treatment, this agrees with the equations:

$$R-NH_2 + HCHO = R-NH-CH_2OH$$

$$R-NH-CH_2OH + H_2N-R = R-NH-CH_2-NH-R + H_2O$$

The action of aluminum salts in hardening the casein is believed to be due to the action of aluminum hydroxide in uniting with carboxyl groups to form aluminum bridges. If aluminum is used for hardening it acts as a mordant for some dyes and also prevents the casein from taking up chromium in chrome mordanting.

Casein has a specific gravity of 1.26 as compared to 1.30 for wool, it is less inflammable than the cellulose fibers, it is warm to the touch, has considerable crimp which is fairly resistant to processing and which gives a full handle, the moisture regain is similar to that of wool, and in spite of the fact that it has no scales nor disulfide linkages it possesses some felting properites although less than wool. In blends with wool, however, at least up to 50 per cent, the addition of casein wool increases the felting of wool in both acid or alkaline media, this is believed to be due to a softening of the surface and a resulting adhesiveness when wet. The affinity of casein wool for acid dyes is greater than that of wool but this affinity may be decreased by acetic anhydride. Further developments of casein wool will be in hardening which will make it more resistant to water but will also tend to decrease the affinity for acid dyes by reaction with the amino groups and make the dye affinity more like wool. It will also probably make the fiber less like wool in its felting properties. Other possible sources of protein for this fiber may be the protein from soya bean or the peanut plant.

In "New Synthetic Fibers in the Dyeing and Cleaning Industry," R. B. Brown and S. M. Brown report on the action of various solvents, spotting agents, and dyes on the new fibers. Solvents in general had no effect except for sometimes a slight harshness. Casein fiber was found to be affected by ammonia, oxalic acid, hydrogen peroxide, and sodium hypochlorite. With stripping agents, casein was strongly affected by formaldehyde-sulfoxalates, titanium salts, potassium permanganate, and hypochlorites; hydrosulfites were recommended. With nylon, formaldehyde-sulfoxalates, sodium hydrosulfites, or ammonia may be used. In dyeing, it was found that casein fibers take up acid dyes heavier than wool and are affected at the boil, this effect is less in neutral baths and at 90° C.; direct cotton colors were taken up heavier than wool. Artilana and Cisalfa showed less affinity than wool for acid dyes in an acid bath; in neutral bath the Artilana was like wool and the Cisalfa less; both dye heavier than wool with direct cotton colors. Acid dyes go on nylon more than on silk, basic dyes less than silk, and direct dyes less than silk; nylon dyes well with acetate dyes but not to the same shades as acetate rayon.

H. M. Bunbury in "Dyeing Properties of the New Fibers" presented an excellent survey of the various dyes and their application to the new fibers; many tables of suitable dyes of each class for each of the new fibers were given. Acid dyes had a greater affinity for casein than for wool but were less fast to washing, the fastness to light was about the same. Chrome dyes acted the same as acid dyes. Direct cotton dyes were heavier on the casein than on wool, the wash fastness was satisfactory though less than on cotton. Viscose fibers containing casein had dyeing properties more like viscose than wool, it was difficult to get depth of shade with acid dyes and such as were obtained

showed poor wash fastness; satisfactory solid shades in mixes with wool cannot be obtained with acid dyes or chrome dyes. Basified viscose was successfully dyed with acid dyes, the wash fastness was good and the light fastness considerably reduced. Chrome dyes were dyed successfully by the after-chrome process. Direct dyes acted the same as on viscose but with a tendency to give reduced light fastness. The synthetic resin fibers showed no affinity for dyes except for some basics. The physically modified viscose acted the same as the viscose and the cottonized bast fibers acted the same as jute except that the affinity for acid and basic dyes was slightly less.

Shrinkproofing Wool—

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of chromic and sulfuric acids, but is applied to wool dispersed in a chlorinated solvent such as carbon tetrachloride.

A practical procedure utilizing chromyl chloride as a shrinkproofing agent for wool is as follows:

Twenty pounds of scoured wool are immersed for one hour at 18 degrees C. in 10 gallons of carbon tetrachloride containing 0.2 gallons of chromyl chloride. The wool is then hydro-extracted, washed with water and then neutralized with either ammonia or soda.

The disadvantages of the above process are—(1) it is more expensive than the sulfuryl chloride method, (2) as the action of the chromyl chloride is strongly oxidizing there is danger of excess wool damage.

At this time it is interesting to note[7] that the British Wool Industries Research Association is experimenting with the use of gaseous chlorine for chlorinating wool. It is understood that this method of application diminishes the possibilities of over-chlorination and secondly gives a more uniform chlorination.

The more intensive work done recently to produce woolen fabrics which are commercially shrinkproof is a result of consumer demand. It is highly possible that the day is not far off when woolen garments, after being properly shrinkproofed, will be subjected to higher temperature washing with soap and other detergents, with a lesser tendency to cleanse these by use of the present dry cleaning methods.

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TRADE NOTES • NEW PRODUCTS

• STEIN, HALL ADDITION

Stein, Hall & Co. is constructing a five-story and basement addition to its factory in Long Island City, New York, which will provide about 27,000 square feet of new production space to meet increased demand for the company's gums and dextrines, which are used by the paper box, envelope, textile and other industries. The addition will be completed in January.

It is stated that construction was started some time before the European war began, so that the expansion is in no sense a "war baby." Increasing business, even prior to the outbreak of hostilities, made the need for enlarged production facilities imperative. The top floor will provide an ideal set-up for enlargement of the Long Island City Laboratory.

Construction is of brick-enclosed steel and the floors will be concrete, so that the structure will be fireproof. The fifth floor will present a penthouse appearance because the walls will be set back from a parapet running around the edge of the fourth floor roof. This penthouse design will help to make the laboratory floor dustproof because its windows will not be in line with those of the factory floors below but will have clear air space all around. The laboratory floor will also be subject to comparatively little vibration. This floor will include rooms for pilot plant operations, instruments, research and routine work. The laboratory will have plenty of daylight from 23 windows and seven skylights.

The addition will have a total of more than 70 windows, most of them unusually large. Even the basement, most of which is above ground will have ample light.

At the north end of the street floor there will be a receiving platform with more than 600 square feet of floor space and two large roll-up doors. The platform at the opposite end of the present building will be used for loading outgoing shipments.

Doors at the south end of each floor and the basement will connect the addition with the present building. The third and fourth and the laboratory floors will be provided with showers.

A new boiler house is being constructed to supply additional steam for heating and production purposes.

Construction work is being done by the W. J. Barney Corp. and the plans were drawn by A. R. Burnette, both of New York City.

• MEXICO'S CHEMICALS

Mexico, which is one of the leading chemical importers of the Western Hemisphere and which in recent years has been obtaining approximately 50 per cent of its requirements from nations now at war, is becoming increasingly concerned over its future supplies of such products, according to the Chemical Division, Department of Commerce.

While complete details are not available, estimates indicate that the United States was the largest single source of Mexico's imports of chemicals in 1938, supplying products valued at $5,500,000. Germany was second with $4,400,000, of which about $2,500,000 consisted of medicinals and pharmaceuticals, the balance being made up of a wide line of products, including coal-tar dyes valued at about $500,000.

France was third supplying approximately $1,000,000 worth of medicinals, toiletries, and other products; Switzerland was a source for dyes and medicinals; the Netherlands supplied considerable quantities of linseed oil and paints; Belgium, zinc oxide and ultramarine; and Italy, citric acid and miscellaneous medicinal products.

At least for some time to come Mexico will no doubt look to the United States for a greater share of its chemical and related product requirements, and the Chemical Division suggests that it might be well for American manufacturers who are interested in the market to forward

all particulars regarding their lines to the leading importers in that country, lists of which may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., or any of its District Offices.

• INCO OFFICER RETIRES

James L. Ashley, Secretary and Treasurer of The International Nickel Company of Canada, Limited, who has been in executive since the formation of the original International Nickel Company in 1902, has elected to retire from these positions under the Company's Retirement System, it was announced by Robert C. Stanley, Chairman and President, following the monthly meeting of directors on November 6th.

While Mr. Ashley now retires as an officer of the Company, he will continue to serve in an advisory capacity for several months. He remains as a director of The International Nickel Company of Canada, Limited and its various subsidiaries. Mr. Ashley has been Treasurer since 1902 and has held the office of Secretary since 1911. He became a member of the board of directors in 1913.

William J. Hutchinson, who served as a director for approximately ten years and a member of the Executive Committee of the present Canadian Company since 1928, and who resigned both offices in 1934, due to pressure of other business, was **elected to succeed Mr.** Ashley as Treasurer. He was also elected a director to fill the vacancy on the board caused by the resignation of William W. Stein, of San Francisco, California, who has been a director for 18 years.

Henry S. Wingate, Assistant to the President of the International Nickel Company, Inc., was elected Secretary of the parent Company.

• DYESTUFFS

Contents of September *Dyestuff* quarterly publication of the National Aniline & Chemical Co., Inc., 40 Rector Street, New York City, are described by the following titles: Screen Printing vs. Roller Printing by Dr. Fr. Streng; The Manufacture of Felt by James P. Eich; Art in Relation to the Textile Industry by J. A. Milne; Men's and Women's Shoe and Leather Colors, Spring, 1940; Finishing Yarn-Dyed Fabrics by C. Norris Rabold; Bleaching Straw Hats by Dr. Gebhardt. Copies are available upon request to the publishers.

• COLOMBIA'S DYES

Colombian textile interests which have been obtaining about 90 per cent of their dye requirements from Germany are becoming increasingly concerned in the present emergency and are looking for new sources of supplies, particularly in the United States, according to a report from the American Commercial Attache, Bogota, made public by the Chemical Division, Department of Commerce.

At the beginning of 1938, Colombia had a total of 67 textile establishments, capitalized at approximately $9,000,000, according to official statistics. Imports of dyes into the country have been increasing steadily during recent years, indicating that the industry is growing steadily. In 1936 Colombia imported a total of 128 metric tons of dyes, in the year following imports increased to 200 tons and in 1938 to 233 tons valued at about $500,000.

Aside from imports of dyes from Germany, small quantities have been obtained from Switzerland, France and elsewhere. Imports from the United States in 1938 aggregated 14½ metric tons valued at $17,000 which compared with 28 tons valued at $30,000 during the preceding year.

The Chemical Division suggests that it might be well for American firms interested in the Colombian dye market to forward full particulars regarding their lines to the leading textile manufacturers in that country, lists of which may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., or any of its district offices.

• APPOINTED TO LABORATORY

Dr. Walter M. Scott has been appointed Chief of the Cotton Chemical Finishing Division of the Southern Regional Research Laboratory at New Orleans, Dr. Henry G. Knight, Chief of the Bureau of Agricultural Chemistry and Engineering, announced recently. Doctor Scott will be responsible for the scientific and administrative work of the Division, which will involve broad research and development work to improve or modify by chemical treatment cotton fibers, cotton yarns, cotton textiles, and cotton fabrics.

Doctor Scott holds a Ph.B. degree in chemistry from the Yale Scientific School and a Ph.D. degree in organic chemistry from the Graduate School of Yale University. He entered the employ of a large silk manufacturing company in 1915 and was its chief chemist for 11 years. Subsequently he was technical advisor to the dyestuff sales department of a dye and chemical concern and director of sales and service for a color manufacturer. During the last 9 years he has acted as service director for a chemical research and development organization.

During the years of his association with the above mentioned companies, Doctor Scott has specialized in problems connected with the dyeing, printing, and finishing of silk, wool, cotton, and rayon fibers and fabrics, as well as in the field of color measurement and specification. He also has had considerable experience with cellulose esters and ethers and the various types of synthetic resins. He is the author of more than 40 technical papers and reviews, and has been granted several patents. Doctor Scott is one of the charter members of the American Association of Textile Chemists and Colorists and has been a member of its council and research committee for many years. He is also Chairman of the Textile Dyeing and Finishing Committee of the American Society for Testing Materials, a member of the American Chemical Society, and a Fellow of the American Institute of Chemists. He is a veteran of the World War and at present holds the commission of Lieutenant Colonel in the Chemical Warfare Reserve.

• DESCRIBES NEWER CHEMICALS

Recently developed solvents for dry cleaning, and the newer types of chemical finishes for textiles, including the durable water repellent and flame-proof finishes, were described by N. C. Cooper, chemist of The R. & H. Chemicals Department of the du Pont Company before a meeting of the West Virginia Laundry and Dry Cleaners Association, Huntington, W. Va., November 9.

Mr. Cooper said that the advantages of chlorinated hydrocarbon cleaning systems as compared with the older naphtha systems were the non-flammability of the fluid; rapid and odorless cleaning, as demanded by today's custom; and reduced finishing cost, owing to ease of spotting and finishing after cleaning.

Regarding recent textile developments, Mr. Cooper said, in part:

"'Zelan' durable water repellent finish is a finish applied to the fabric in the piece. It is described as a durable finish, as it resists the action of cleaning and laundering, and it is likely to last the useful life of the fabric. It cannot, however, be applied to the garment after manufacture.

"'Aridex' water repellent, on the other hand, may be applied by the dry cleaner in his own establishment. Although it is removed by dry cleaning or laundering it has been found valuable for such articles as table cloths, furniture slip covers, carpets, **summer garments, and** light weight coats. It has the effect of preventing the absorption into the fiber of many stains of a water soluble nature. An unabsorbed stain can be removed much more easily than one which penetrates the fiber itself.

"Another product which appears promising, particularly for curtains and drapes, is a flame-proofing finish. One of the most recently developed flame-proofing chemicals is based on ammonium sulfamate, which may be applied to the fabric in the cleaning

plant. This material is particularly desirable because it does not affect the feel or handle of the fabric and has little or no effect on most dyestuffs.

"Finishes are available which prevent mildewing of fabrics. Some of these are durable, while others are removed by cleaning. Such articles as shower curtains are improved by these finishes.

"Developments of crush resistant velvet makes this popular fabric more serviceable and improves the ease of handling in the cleaning plant. Certain finishes which impart this property to velvet are substantially permanent. They are obtained by the application of various chemicals such as urea-formaldehyde resin.

"Some finishes are applied to fabrics to reduce slippage of the yarns in fabrics. Results obtained have been most impressive on certain rayon, satin and taffeta fabrics. Both natural and synthetic materials have been found of value for this purpose. Rosin, obtained from certain species of trees, is used extensively. Urea-formaldehyde resin is similarly used.

"The recent development of nylon fiber and monofilament may eventually be of interest to laundrymen and cleaners. The productive capacity is not great, but it is hoped that sufficient capacity will be available next year to permit exploring the possibilities for purposes other than stockings and tooth brushes."

• COAL-TAR DYE EXPORTS

United States exports of coal-tar colors, dyes, stains and color lakes advanced sharply to 1,024,000 pounds valued at $610,245 in September, more than double the amount shipped to foreign countries in the corresponding month of last year, the Chemical Division, Commerce Department, announced recently.

More than half the total, or 694,000 pounds, went to Canada in September. China was second with purchases aggregating 77,000 pounds during the month, followed by Belgium with 31,000 pounds; Brazil, 29,000 pounds; British India, 28,000 pounds; Sweden, 23,000 pounds; Mexico, 22,000 pounds; and Cuba, 18,500 pounds. Smaller shipments went forward to 37 other countries during September.

Exports during September brought the total for the first nine months of the year to 7,776,500 pounds valued at $3,591,148 compared with 6,414,000 valued at $2,755,631 in the corresponding months of 1938.

American coal-tar dyes are normally shipped in varying quantities to almost every foreign country and trading area of the world, where they must compete with the products of other large world dye producers, particularly Germany, which is believed to be the world's largest producer and exported of such prdoucts. In 1938 Germany exported a total of 61,000,000 pounds of coal-tar dyes valued at about $44,000,000, official German statistics show.

In the present emergency it is not unlikely that many foreign countries will look to the United States for a greater share of their coal-tar dye requirements, the Chemical Division reported.

• ACIDSEAL PAINTS

A four page catalog section on its line of Acidseal Paints, derived from rubber by a process which it developed and patented, has just been published by The B. F. Goodrich Company, Akron, Ohio, and is now available upon request.

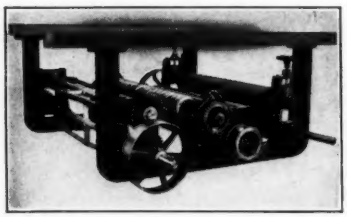
The subject is interesting to the textile field because of the paints' unusual properties as coverings for textile mill interiors as protection against humidity, and because it also dries before lint and dust can accumulate, in dyeing and bleaching mills, protection of laboratory equipment, mixing drums and reaction kettle covers, as well as machinery of various kinds and many other uses.

Acidseal paints, according to the manufacturer, are different from any other type of paint, lacquer, or coating, with strong adhesion, corrosion resistance and elasticity as characteristics. They dry by evaporation, during which the solid material is united to metal or any other clean, dry surface with practically an inseparable bond. They have many of the elastic properties of rubber, the hard, firm film conforming to the expansion, contraction or vibration of the painted surface without cracking.

The catalog section lists all properties of the product, directions for use, each type, with its special properties, and includes an exact reproduction of the different colors in which the paints are made.

• BALL BEARING SCUTCHER

A new heavy duty ball bearing scutcher has recently been placed on the market by Birch Bros., Inc., 32 Kent St., Somerville, Mass.



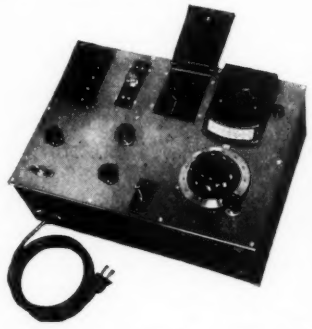
It is built with all shafts of increased diameter; spiral rollers with brass bodies and heavier brass threads; beaters of special construction; governor with ball bearing rolls of increased diameter and ball bearing pivot stud; gears cut phenolite and cut cast-iron to reduce wear and noise. All ball bearings are S. K. F. properly housed and self-aligning, and all parts are dowelled to position. The frames are of cast-iron, cast integral with the hangers and feet.

In the single roller type the roll is of brass; in the double roller type (where the scutcher pulls the cloth) the rolls are rubber covered with a special composition to eliminate slippage. Pressure is applied to the top roll by pressure screws and handwheels. The machine is made in all widths from 24 inches to 120 inches.

• PHOTO-ELECTRIC COLORIMETER

A photo-electric colorimeter, incorporating a number of distinctive features, is being announced by Dr. F. Loewenberg, 10 East 40th Street, New York City.

The Lumetron Colorimeter has been designed for the greatest possible flexibility and for obtaining results reproducible within the narrowest possible limits. The construction of the colorimeter allows the use of a great variety of sample holders and light filters, including monochromatic filters. As a result, the instrument covers a wide field of application, ranging from simple measurements of light transmission of liquids to colorimetric and turbidimetric chemical analysis and to abridged spectrophotometric determinations. Special provisions have been made for the accurate measurement of extremely dark and extremely transparent liquids.



It is stated that for best reproducibility of readings, the design of a colorimeter must take into account the secondary influences to which photocells are susceptible. In designing the Lumetron Colorimeter, special care has been taken to eliminate errors due to optical, thermal and electrical effects and to obtain stable and linear photocell response.

The Lumetron Colorimeter uses two blocking-layer photocells in a balanced circuit. This makes it possible to operate the instrument from the power line without the use of batteries or constant-voltage transformers. Line voltage changes have no effect upon the readings obtained.

The list of filters available comprises broad-band filters, tri-color filters, monochromatic filters, filters producing an overall spectral characteristic approximating that of the human eye under daylight conditions. A neutral multiplier filter is used

for measuring liquids of such low transmission that the reading would come close to the zero position of the dial. Special models can be furnished with built-in range switches to spread the dial readings over any desired limited transmission range.

• PULMOSAN FOLDER

The Pulmosan Safety Equipment Corp., Johnson and Spring Sts., Brooklyn, N. Y., has just published a 4-page folder entitled "Safe Handling of Acids and Chemicals," which is of value to every plant where workers handle Acids, Chemicals or Caustics. The folder illustrates and describes a full line of specialized protective equipment, including Aprons, Gloves, Sleeves, Hoods, Goggles, Respirators, Carboy Truck and Tilter, Carboy Siphon, Acid Pails and Dippers, etc. A copy may be obtained by addressing the firm above.

• CATALOG OF INFILCO EQUIPMENT

Infilco products for chemical mixing, feeding and proportioning, for hydraulic measurement and control, and for conditioning water, processing liquids and trade wastes, all are illustrated and briefly described in a new condensed catalog issued by International Filter Co., 325 W. 25th Place, Chicago, Ill. Copies of this Bulletin No. 50 can be obtained upon request. The catalog will be of special value to many industrial and processing plants, for it offers information in a compact form on all types of equipment used in such plants for liquid or waste treatment, chemical feeding and hydraulic control. Descriptions of equipment are supplemented by over forty illustrations.

• DYEING AT WORLD'S FAIR

Widespread general interest in dyes and dyeing was revealed by a large percentage of the 5,350,000 visitors to the du Pont "Wonder World of Chemistry" exhibit at the New York World's Fair who stopped after the dyestuffs demonstrations to ask questions, according to exhibit records analyzed since the close of the Fair.

The questioners were divided into three classes: the consumer, students and teachers, and men in the dye and dye-consuming industries.

One question most frequently asked was: "How can you identify a fabric or garment which has been dyed with a fast dye?" Many visitors learned for the first time of the existence of the "Color Tested" seal, used to certify materials which have been tested for color fastness by the Better Fabrics Testing Bureau, Inc.

Teachers and students were interested in the chemical basis of the demonstrations. Typical questions were: "What happens in that beaker which makes the yellow fabric turn blue and the blue fabric turn yellow?"; and "What oxidizing agent do you use in vat dyeing?" There were many requests for the fabrics that were selectively dyed—a white piece of cloth dipped into a mixture of dyes in the same beaker emerging four different colors owing to the selective dyeing of its four kinds of fibers. Several teachers asked how research has made the American dyestuffs industry self-sufficient since 1917.

Men in the dye and dye-consuming industries asked technical questions about specific dyestuffs and their application, as well as outlining various dyeing problems they had encountered.

Vat-dyeing demonstrations averaged forty each day, a total of 7,200 for the duration of the Fair. The selective dyeing demonstration was performed an equal number of times.

Laboratory control apparatus for testing the fastness of dyes to sunlight generated the equivalent of 2,808 hours' exposure to summer sun between the hours of 9 a.m. and 3 p.m. during the month of June with a clear sky. This testing device had been carefully calibrated to correspond to the enumerated standard conditions.

A machine for pre-testing the fastness of dyes to laundering washed various dyed fabrics for a total of 2,160 hours, equivalent to the time consumed in doing the average family wash for 1,080 weeks.

Du Pont chemists explained that these two pieces of testing apparatus shown at the exhibit exemplified the methods used to pre-test a dye in the control laboratory, where a color may be exposed to as many as 240 color-destroying influences to determine just what the processor can expect from it.

• BOOK REVIEWS •

Handbook of Chemistry and Physics. *Twenty-Third Edition. Charles D. Hodgman, M.S., Editor-in-Chief. Published by Chemical Rubber Publishing Co., 900 West 112th Street, Cleveland, Ohio. 2,221 pages. Price* $6.00. *Special rates to teachers and students.*

Previous editions of this book are so well known that in most instances the present new edition needs no introduction. In the preparation of the twenty-third edition a more or less complete revision has been made and the following features have been added:

Melting Point Index of Organic Compounds.
Boiling Point Index of Organic Compounds.
Potentials of Electrochemical Reactions.
Free Energy.
Ionization Potentials.
Ratio Tables for Bridge Calculations.

Extensive revisions have been made in the following:

The Elements.
Isotopes.
Gravimetric Factors and Their Logarithms.
Definitions of Chemical Terms.
Composition and Value of Foods.

This volume provides a very complete reference book regarding both chemistry and physics. The table of chemical properties of both inorganic and organic substances is very complete. Thirty-eight different authors have collaborated in its preparation. It represents by far the most complete edition of this book which has so far been published.

1939 Compilation of ASTM Standards on Textile Materials. *320-pages. A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia,* $2.00 *per copy in heavy paper cover.*

All of the specifications, tolerances, tests and definitions developed by the American Society for Testing Materials through the work of Committee D-13 on Textile Materials are included in this 1939 textile compilation. Following nine general standards covering textile machines, identification and determination of cotton fibers, general tests on woven fabrics, knit goods, etc., there are three standards covering asbestos roving, yarns and tape. The section on cotton is one of the major portions of the book with twenty-one items included involving test methods for shrinkage, fastness to washing, general methods for testing cotton fiber properties, and cotton yarns and

threads. Other specifications and tests cover hose and belt ducks, numbered ducks, light and medium weight fabrics, and cotton goods for rubber and pyroxylin coating. Other specifications cover cotton sheeting, terry toweling, tubular sleeving and braids, tire fabrics and tire cord and Holland cloth.

There are two items covering jute yarn and Cuban sugar bags followed by seven pertaining to rayon which include test methods for continuous filament yarns, rayon staple, spun yarns and threads, strength of woven fabrics when wet, fastness to washing, shrinkage, and yarn slippage of silk and rayon fabrics.

The significance of the work in the field of wool is indicated by ten standard specifications and methods covering hard scoured wool in grease wool, wool fineness, fiber length, wool tops (fineness) woolen yarn, worsted yarn, wool felt, wool and part wool fabrics, wool yarns mixed with other fibers, and pile floor covering.

Another valuable part of this textile pamphlet sponsored by Committee D-13 is the abstracts of papers presented at committee meetings. In the current issue there are five included in the Symposium on Spun Rayon and three more are papers presented at the Twenty-Fifth Anniversary Meeting of the committee.

Appended to the manual are nine sections covering the following: photomicrographs of common textiles fibers, yarn number conversion table, psychrometric table for relative humidity, and a glossary of terms relating to textile materials. Five proposed methods published for information and comment pertain to correction of breaking strength to standard regain, test for accelerated aging of textiles, quantitative determination of Tussah silk in mixtures with other fibers, quantitative analysis of textiles, composed of wool and lanital and test for shrinkage of grease wool.

• OPEN FORUM •

Rules under which this department of the REPORTER is conducted are as follows:

1. Anyone who has a technical problem on which he would like advice may submit it to the Reporter and it will be published in the first available issue.

2. Any reader who feels that he has a solution of the problem may forward his reply to us and if we feel that the reply is suitable it will be published in a succeeding issue.

3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

47—In recent months we have experienced an entirely new trouble, the very uneven package dyeing of several lots of mercerized yarns, both high grade Combed Peeler and Sak, and both warp and skein mercerized. Satisfactory formulas and methods in the same dyeing machines on the same day act entirely differently on different lots of yarn, therefore methods or water or machines or dyestuffs are not responsible. The dyeing is uneven and the shade is entirely off. On the worst yarn lots there is an actual precipitate from the dyestuff on the outside of the packages. The dyeing is direct, also developed. The worst yarn is also troublesome in skein Vat Dyeing, not in unevenness but in consuming 20 per cent too much dyestuff. The yarn which dyes unevenly with direct dyes in packages can be dyed nearly evenly in skeins with special care. The package dyeing is done in the original wetting out bath and no betterment when the yarn is separately boiled out with scouring or soluble oil. None of the troublesome yarn shows an alkaline reaction from imperfect souring but in some cases a slight souring before dyeing has helped and in other cases no. We notice the most troublesome yarn takes many times as long to wet out in the standard laboratory wetting out test as the satisfactory yarn but in the uneven dyeing we are sure the yarn was properly wet out. In other words the troublesome yarn seems to be to a certain extent waterproofed and to have a precipitating effect on dyestuffs. There are certain chemicals used on Cotton, which are permanently absorbed by cotton and which produce results identical with the above, but the spinners say they use no chemicals whatever and the mercerizers use only caustic and proper souring procedure. What do you say is wrong with the troublesome lots of mercerized yarns and can you suggest remedies? **G.L.**

• CLASSIFIED •

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Chemist desires position. Twenty-seven years' experience. Fast colors, new finishes, all types laboratory work, yarn, piece goods, cotton or rayon. Excellent health. Write box No. 212, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Textile chemist with 11 years experience in cotton, rayon, silk, wool; bleaching, dyeing, printing, and finishing. Supervise all operations, all types laboratory work. Age 33, married. Desires position in textile finishing plant or technical service. Write Box 166, American Dyestuff Reporter, 440 4th Ave., New York, N. Y.